

RESTORATION: THE BOEING 307 STRATOLINER DRIES OUT

AIR & SPACE

Smithsonian

SEPTEMBER 2002

HONEYMOON IN SPACE

ARE WE THERE YET?

PAGE 46

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SUBJECT *The family of astronaut
Frank Borman watches the launch
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Smithsonian

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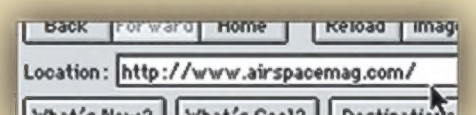
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Imagine spending your next vacation in artist Paul DiMare's enchanting hotel, floating above Earth and surrounded by stars. (Will honeymoon suites be next?)

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Garber's Half-Century

As a peerless collector and head curator for the National Air Museum, which had been created in 1946, Paul Garber was responsible for the increase and preservation of the Museum's excellent but largely unseen collection of aircraft. The collection suddenly grew after World War II when U.S. Air Force General Henry "Hap" Arnold gave the Smithsonian an astounding treasure: 97 Allied and Axis military aircraft—the most extensive collection in the world.

In 1948, Garber found a home for the collection in a government-owned aircraft factory in Park Ridge, Illinois, a suburb of Chicago. But two years later, the onset of the Korean War required the factory to be re-opened, and Garber was given an eviction notice.

With the clock ticking, Garber and a crew of four helpers began working tirelessly to pack up for a move. Garber also looked for a new facility. Finding no warehouses in the Washington, D.C. area, Garber took to the air with a friend in a Piper Cub to survey the surrounding area and spotted a promising site in the Silver Hill neighborhood of Suitland, Maryland. A planned housing project on the tract had been shelved, so the land was available. Garber acquired the 21 acres for the Smithsonian in 1952.

Almost single-handedly, he scrounged tools and equipment from the U.S. Army, surplus prefabricated buildings from the Navy, and free concrete from a local company to build the new complex. The Air Force paid for shipping the aircraft, and by that summer—five decades ago—the last of the aircraft arrived.

For almost 30 years, the staff at Silver Hill protected the Museum's aircraft in the hope that a much larger museum

would be built. Construction of the National Air and Space Museum was authorized by Congress in 1966, and after it opened its doors on July 1, 1976, the Museum turned its attention to refurbishing Silver Hill.

On June 1, 1980, Silver Hill was named the Paul E. Garber Preservation, Restoration and Storage Facility. Garber was present to see the Smithsonian recognize his life's work; he died 12 years later. His commitment to our aeronautical heritage enabled millions to see the aircraft that made history.

The Garber facility has been home to the Museum's restoration shop and has provided a secure shelter for aircraft, spacecraft, and over 30,000 other aerospace artifacts, but today we have a problem similar to the one Garber faced 50 years ago. Unlike him, we have thousands of generous donors helping to solve it. After half a century we have outgrown the confines of Silver Hill. In keeping with Garber's spirit, we are well on the way to completing a new facility that honors his dedication and continues his legacy. On May 30, the last of 21 support trusses was hoisted into position for the aviation hangar at the new Steven F. Udvar-Hazy Center at Washington Dulles International Airport in Virginia. Soon the roof will be completed and attention will turn to the structure's interior. We are ahead of schedule and on budget for opening this impressive facility by December 17, 2003, the centennial of the first powered flight. In this way we will be able to carry on Paul Garber's work for the next 50 years and well beyond.

—J.R. Dailey is the director of the National Air and Space Museum.

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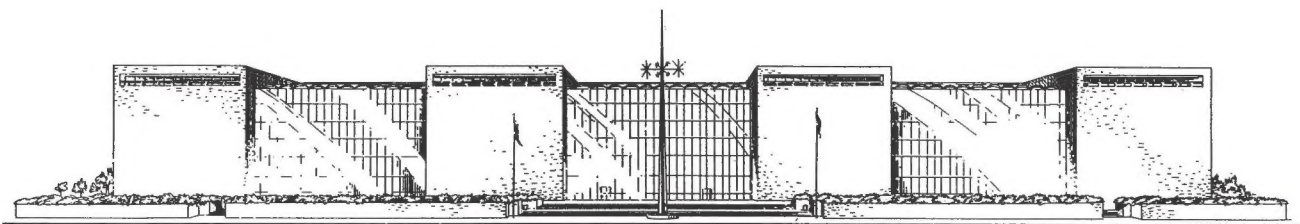
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LETTERS

Lindbergh's Secret Identity

Reeve Lindbergh's first flight ("My First Time," June/July 2002) took place while I was a flight instructor at the Danbury School of Aeronautics in Danbury, Connecticut.

Whenever Charles Lindbergh reserved a plane, the owner of the flight school, Stan Konecko, put him on the rental schedule as "Mr. Ginsberg" and instructed the airport employees not to disturb him.

I have always been in awe of Mr. Lindbergh. Whenever I saw him, I wanted to shake his hand, but never had the guts to disobey orders. But guess what? I now own N82677, the very same Aeronca Reeve Lindbergh was in when she and "Mr. Ginsberg" were forced to land in a cow pasture.

Frank Giumarra
 Danbury, Connecticut

Long-Distance Damage

After the September 11 attacks, Congress rushed to compensate the commercial airlines for their losses but left general aviation out in the cold, so I appreciated "A Price Too High" (June/July 2002). My only complaint is that the selection of airports your article covered could suggest that only airports around Washington, D.C., suffered. The family-owned airport in Washington state where I fly out of was also closed for a time after September 11, and I have heard painful stories of financial problems. All the flight instructors here had to go on unemployment. Also, our airport is just inside Seattle Tacoma International's Class B airspace, and VFR (visual flight rules) flights from airports in that class were prohibited for much longer than VFR flights from other airports.

Tom Donnelly
 Seattle, Washington

A MiG's Achilles Heel

In the sidebar of "Russian Revolution" (Apr./May 2002), Tobe Gooden recounts that flying a MiG at more than 500 knots "feels like being in a car when you lose power and can't use the power steering." That description reminds me of a story I heard about a U.S. Navy F-4 pilot encountering a MiG head-on over North Vietnam. The F-4 pilot tried to turn and get a shot at the MiG, only to discover that the MiG pilot had almost completed his turn. He was pulling too hard, and his tracers were passing in front of the F-4.

The F-4 pilot rolled into a vertical dive and the MiG followed. As the speed rapidly built up, the F-4 pilot pulled out of his dive, but the MiG pilot, now going in excess of 500 knots, just kept heading for the ground. You don't always have to shoot them down.

Gerald P. Hanner
 Papillion, Nebraska

A Wing With Thrust

I question ornithopter builder James DeLaurier's statement that his wing is the first to provide both lift and thrust ("Ready, Set, Flap!," Dec. 2001/Jan. 2002). I recall that the BAC (Hunting) H.126 Jet Flap research aircraft of the early 1960s diverted a large portion of the exhaust from its single Orpheus engine to a narrow slit along the trailing edge of the wing. While much of the wing-slit exhaust was used to increase the lift coefficient of the flaps, a portion actually provided thrust.

Carlton A. Stidsen
 Tolland, Connecticut

Who Left Those Prints on the Moon?

The photograph on page 61 of "Shooting the Moon" (Apr./May 2002) is identified as showing the tracks of a lunar rover. Rovers did not fly until Apollo 15, and Tommy Gold's camera was not brought on that or subsequent Apollo missions. Also, the wheels for the lunar rovers were metal mesh and would not produce the tread shown in the picture. I believe the photo is a close-up of a boot print.

Dan Nelson
 retired engineer,
 North American, Rockwell, and Boeing
 Cypress, California

A Sight for Sore Eyes

"The Birth of Spooky" (June/July 2002) brought back memories of a very long night on a hilltop in the Ashau Valley of South Vietnam in 1969. I was a U.S. Army helicopter pilot just coming to a hover when a North Vietnamese RPG (rocket-propelled grenade) struck our UH1-H Huey right under the main rotor. My copilot and door gunner survived, as did some of the infantry we were inserting on the hilltop.

Our lofty perch turned out to be on top of a North Vietnamese Army tunnel complex. The enemy troops were determined to remove us from their roof. Artillery and air strikes kept their heads down through the afternoon.

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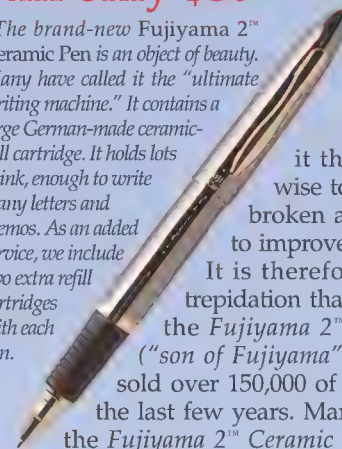


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LETTERS

Just after sunset, the first AC-47 Spooky arrived. It was the most beautiful sight I had ever seen. From our vantage point, the fire power was amazing: streaming, wavy lines of solid light snaking down all around us through most of the long night. We were extracted the following afternoon. I am quite sure that Spooky saved our lives that night. Thanks, Spooky!

Steve Brownell
Irvine, California

Gone With the Wind Tunnels

As a graduate student in mechanical engineering with a knack for seeing fluid flows, I greatly enjoyed "The Man Who Could See Air" (June/July 2002). I wish I had worked back in the days when researchers were allowed to conduct trial-and-error tests with government-funded wind tunnels. Truly revolutionary discoveries were made this way, as Richard Whitcomb's work shows.

Now, with test time costing millions of dollars and strict research proposals being scrutinized years in advance of an actual experiment, there no longer seems to be a place for a non-mathematical theory. If you come up with a concept,



F-111B prototype: an underachiever?

you must now prove it on paper before you can prove it in reality. Think of how much time was saved by creating a new type of wing first, *then* figuring out the physics behind it. I hope someone in Washington will take this to heart and allow researchers to dream and "play" again.

Michael W. Martin
Picayune, Mississippi

Unfulfilled Pig

Had Grumman's F-111B been allowed to evolve along with the U.S. Air Force (and Australian) F-111s, it might have fulfilled other missions besides the Phoenix-missile-equipped interceptor role ("The Plane With No Name," Feb./Mar. 2002),

perhaps serving as long-range strike, reconnaissance, or electronic platforms. Symbolizing the wasted potential, the prototype F-111B is now in a Mojave, California junkyard (left).

Mark W. Anderson
Fallbrook California

Correction

June/July 2002 Soundings, "Aiming for the Ignorosphere": We regret misspelling Vic Prather's name.

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— AGNES BROWN

Museum docent Agnes Brown stands in front of the Douglas DC-3 on display in the Museum's Air Transportation Gallery. Her late husband flew this type aircraft during the invasion of Normandy and the Berlin Airlift.

Our children will become tomorrow's scientists, engineers, pilots and astronauts. They will inhabit the Space Station, fly missions to Mars, and set new records in aviation and space flight. But their spirit and imagination will be driven by what they learn from the past.

Agnes Brown, museum docent, knows this well. As a retired principal, she has an excellent perspective on what the Museum can offer future generations. That's why she's included a gift annuity for the Museum in her estate plans.

If you would like to make a gift of lasting significance to the National Air and Space Museum, fill out and return the reply form below, or call 202-357-2493. You may also e-mail gayle.union@nasm.si.edu. Support a lifetime of learning!

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A&S 8-02

M, L, and XL Only

Nancy Currie could be forgiven a case of spacewalk envy. During her last two missions, she spent her time in orbit driving the shuttle's robot arm so her spacewalking crewmates could work. That's as close as the 5-foot-tall, 110-pound former helicopter pilot will ever get to making a spacewalk herself. Currie doesn't lack skills. She lacks a spacesuit.

Citing budget shortfalls, NASA suspended plans to develop a small-size spacesuit, which would have fit 95 percent of the women—as well as some of the men—currently in the astronaut corps.

NASA's spacesuits are an amalgamation of different-size coverings for arms, legs, hands, and feet, all mounted to a hard upper torso base, which currently is available in three sizes: medium, large, and extra-large. The suit fits 90 percent of the male astronauts but just 60 percent of the females, who tend to have narrower chests and shorter arms.

In the late 1990s, as the agency prepared for a steep increase in the number of spacewalks to build and maintain the International Space Station, engineers began designing and testing a small spacesuit torso to accommodate at least seven women in the corps who could not wear a medium-size suit. And there were more than a dozen other female astronauts who made do with a larger size but who might have been more comfortable in the small suit.

Researchers are somewhat concerned that shelving a suit for women will affect biomedical research planned for the space station, but NASA says that height requirements for the station's Russian-built emergency escape ships are more likely to disqualify women than lack of a spacesuit. In addition, the agency is considering lifting the

requirement that all three station crew members, who also serve as test subjects for medical research, be certified to conduct spacewalks, says NASA spokesman James Hartsfield.

Scientists say male-skewed research hurts the program. "Gender is germane to biomedical research," says Jeffrey Sutton, director of the NASA-funded National Space Biomedical Research Institute in Houston, Texas, which develops countermeasures for the bone loss,

cardiovascular changes, and other undesirable effects of space travel. "In our research, we follow protocols of the NIH [National Institutes of Health], so we try to get a cross-section of the population."

NASA had already spent more than \$6 million to develop the small suit before deciding to shelve the program. Finishing the project would take about another \$9 million, says Allen Flynt, head of NASA's extravehicular activity office in Houston.

—Irene Brown



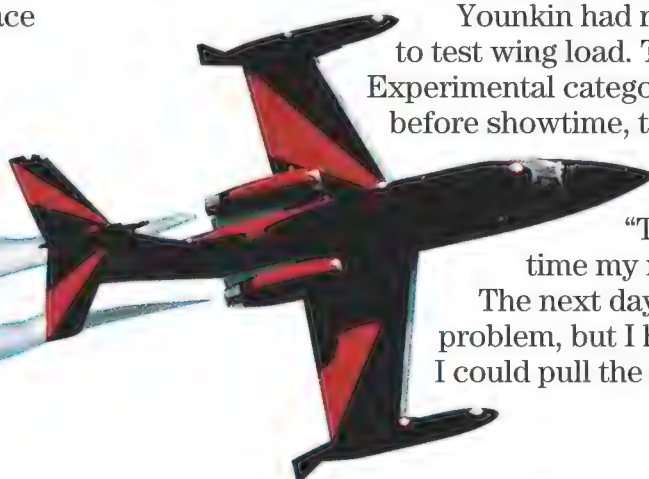
DAVID CLARK

Not Your Father's Learjet

Bobby Younkin's Model 23 turbojet is the ninth Lear aircraft built, and the second oldest flying, and he figured the old dog could learn new tricks. At the Experimental Aircraft Association's Sun 'n Fun Fly-In in Lakeland, Florida, last April, he flew the Lear's first aerobatic display, or at least the first Federal Aviation Administration-endorsed display. "A lot of pilots brag about having rolled their Lear," Younkin says. "I brag that I never rolled until approved to do so."

Younkin had nosed into sustained climbs, rolling side to side to test wing load. The Lear couldn't roll on the record until Experimental category operating limitations were in print. Weeks before showtime, the FAA recategorized his Lear. "The airplane's got a fantastic roll rate, at least 180 degrees per second," Younkin says, adding: "That's just a guess—I've never been one to time my rolls."

The next day he looped the Lear. "Getting up high is no problem, but I had to establish the minimum altitudes where I could pull the airplane through. I want at least 5,000 feet for



COURTESY BOBBY YOUNKIN

my personal minimum [altitude], and my maximum airspeed is 140 knots before I start down the other side. The aircraft starts gaining speed real quick when you point the nose down."

Younkin will take the Lear to 15 U.S. airshows this season. His 12-minute routine of loops, barrel rolls, and a Cuban Eight push pilot and airframe to three Gs positive, well within the design limits of 4.4 positive and 2.0 negative for the classic business jet, whose T-tail and wing form were inspired by the Swiss P.16 fighter. "It's a business jet, but it's got more power-to-weight [ratio] than just about anything in civilian hands," he says. "But I don't need to be going 500 miles an hour to impress people. I can slow down and turn tight, inside the aerobatic box."

Younkin has flown at airshows since 1983, mostly in another corporate classic, a 1942 Twin Beech D-18. "I got involved in a freight and corporate passenger operation, based in a Lear 24B," he says. "That's where I got the idea: Lear shows."

"The general public figures every small piston is a Cessna and every small jet is a Learjet," he adds. "Well, this is a Learjet."

—Roger A. Mola

A Titan's Swan Song

Rolling a brand-new rocket out of a cargo airplane isn't usually an occasion for tears. But emotions were running high when the first and second stages of a Titan 4B rocket were unloaded from a C-5 Galaxy at Florida's Cape Canaveral last May 1. "It's bittersweet," said Technical Sergeant Jeffery Evans, a mechanic with the Air Force's Third Space Launch Squadron, watching the arrival of the last Titan ever made.

The components are being assembled into a heavy-duty vehicle that is scheduled to launch a military satellite next April. It will be the last Titan shot from the Cape, and one of the last shots ever for what was until recently the nation's most powerful unmanned rocket. Lockheed Martin is supplanting the Titan 4 with an even mightier single-use vehicle, the Atlas 5.

When the last Titan 4 flies in 2004, it will carry almost 50 years of space and missile history with it. Boasting more than 350 launches, Titan became one of Lockheed Martin's most recognizable programs. From Titan 1—the first



LOCKHEED MARTIN

Bye bye, Titan: The venerable launcher will soon be upstaged by the Atlas 5.

intercontinental ballistic missiles based in underground silos—evolved the Titan 2 ICBM, the Titan 3 space launch vehicle, and ultimately the Titan 4. The first Titan 2 used for human spaceflight launched a Gemini capsule carrying Virgil Grissom and John Young into a three-orbit mission on March 23, 1965. The Air Force collaborated with NASA on Titan 3, four of which boosted pairs of robot probes—Vikings to Mars and Voyagers to the outer planets—in the mid-1970s.

Lockheed Martin produced more than 140 Titan ICBMs, once the vanguard of America's nuclear deterrent force. After Titan 2s were deactivated in the mid-1980s, the Air Force contracted with Lockheed Martin to modify 14 missiles so they could be used as space launch vehicles. In 1994, a Titan 2 lofted the first U.S. moon mission in two decades, the Clementine orbiter, for the Department of Defense's Ballistic Missile Defense Organization.

Intended to handle defense department payloads that had been designed to fit in the space shuttle, the Titan 4 never lived up to its billing as the military's "assured access" alternative after the 1986 *Challenger* disaster grounded the rest of the shuttle fleet. From its first flight in 1989, it suffered a multitude of technical problems and launch delays. One was delayed so long that it rusted on its launch pad. The 22nd and last of the original Titan 4s blew up on launch in August 1998, spewing fiery debris—rocket and spy satellite—over the Atlantic Ocean.

The 4B, an upgraded version with safer solid rocket boosters and 25 percent more thrust, debuted in 1997. The first one with a liquid-fuel Centaur upper stage dispatched NASA's nuclear-powered

UPDATE

Reunion

Last June, Atsushi Asamura, a former pilot in the Japanese navy, was reunited with one of his aircraft, the Aichi Seiran, at the National Air and Space Museum's Paul E. Garber Preservation, Restoration and Storage Facility in Suitland, Maryland. During world War II, Asamura was a lieutenant assigned to lead a submarine-borne bomber force on a mission that was initially intended to bomb the Panama Canal ("All and Nothing," Oct./Nov. 2001) but was later amended to target Ulithi, a Pacific anchorage of the U.S. fleet.

Although the Seiran's wings had been removed in preparation for moving the

airplane to the new Steven F. Udvar-Hazy Center at Dulles International Airport in Northern Virginia, the fuselage is accessible on its storage cradle. Asamura, 80, was invited to board the airplane via a sturdy ladder. The athletic Asamura bounded up the ladder and into the cockpit. "His fingers floated over the switches and knobs, just barely touching them, like they were surrounded by a force field," says NASM curator Dik Daso. "He recalled that the gyro compass, a five-inch disk near his right knee, was one of the most expensive pieces of equipment ever used in a Japanese aircraft."



ERIC LONG

Atsushi Asamura was assigned to lead a submarine-borne bomber force of Seirans in World War II. Today he finds the cockpit as snug as ever.

robot probe Cassini to Saturn.

Either of two optional upper stages gives the 4B its extra kick and the ability to put 47,800 pounds into low Earth orbit from Cape Canaveral. Launch team members sometimes name each booster and upper stage. Some have honored space pioneers, like the 4B Centaur christened Gus (Grissom) and John (Young) for its February 2001 launch. Others have borne more irreverent monikers—Ren and Stimpy, Arnold (after the pig on the sitcom “Green Acres”), Bart (as in Simpson), and Elwood and Jake (the Blues Brothers).

When production concluded last spring, five Titan 4Bs and three smaller Titan 2s remained to be launched. At California’s Vandenberg Air Force Base late in June, a Titan 2 boosted a weather sentinel for the National Oceanic and Atmospheric Administration. The rest of the missions included a top-secret affair for the National Reconnaissance Office on a Titan 4B that was to take off from Florida late this year.

—Beth Dickey

On The Road Again

Lawrence B. Richardson may not occupy an esteemed place in aviation history. In fact, you’ve probably never heard of him. But 77 years ago, Richardson was a top pilot in one of the nation’s biggest airshows. On October 8, 1925, he flew a Martin Commercial biplane to a perfect score in the inaugural Ford Air Tour—a 1,775-mile race that traversed 13 cities

Edsel Ford and several Detroit businessmen launched the Ford Air Tour in 1925 to instill public trust in an industry born that year, when Congress awarded contracts for the government’s airmail delivery. Initially called the Airplane Reliability Tour, the races varied in length and route over the years. The longest lasted a month and stretched 6,300 miles. Contestants were originally scored on the speed of takeoffs and landings and average speed en route; later, the winner was whoever got to the destination first.

Now, a wealthy vintage airplane owner wants to re-create the tours to celebrate pilots like Richardson and entrepreneurs



Captain Eddie Rickenbacker (with flag) was the starter for the 1926 Ford Air Tour, which launched from Henry Ford’s airport in Dearborn, Michigan.



2002 SCOTT HIGHTON

13 Million Moving Parts in Close Formation

Last June the Hiller Aviation Museum held a “Piasecki Parade” of tandem-rotor helicopters at San Carlos, California. The Tandem Rotor Heavy Lift Helicopter—dubbed Flying Banana—was the brainchild of helicopter pioneer Frank Piasecki. This was the first time all the tandem-rotor helicopters originating from Piasecki’s designs have flown together. Bottom to top: restored Piasecki HUP-1 Retriever, designed for Navy carrier duty and Search And Rescue; restored Piasecki H-21 Shawnee, Army troop transport and Air Force SAR; Boeing Vertol CH-46 Sea Knight, Navy logistics support and SAR; Boeing Vertol CH-47 Chinook, Army heavy lift logistic support.

like Ford. “I really want to do something big to celebrate the centennial of powered flight next year,” says Gregory Herrick, president of the New Brighton, Minnesota-based Sky Media, LLC, which owns the Historic Aviation catalog company. Herrick formed a nonprofit organization, Aviation Foundation of America, to raise the more than \$1 million needed to re-create the tour.

Using the U.S. Civil Aircraft Series and

IN A NUTSHELL

Business jet pilots turn to *Business & Commercial Aviation* for an occasional briefing on the state of the world’s airports...and then some. A scan of the magazine’s June and July issues of International Ops Notes: Safety Alerts and Procedural Advisories From Around the Globe tells you pretty much all you need to know about the political, economic, and epidemiological goings-on around the globe at that time.

Argentina: The effects of the ongoing Argentine economic crises have subjected its residents and occasionally visitors to financial restrictions, delays and other inconveniences. Financial sector difficulties and trade

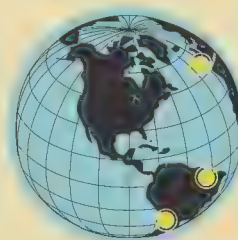
restrictions may occasionally affect access to banking and ATM machines.

Source: *Universal Weather and Aviation*

Azores: Santa Maria (LPAZ) Airport will be closed from 2359–0600 (local) until July 31 with the exception of

emergency operations. Source: *Universal Weather and Aviation*

Brazil: As of April 2, there have been 104,469 cases of dengue fever, resulting in 40 deaths in the state of Rio de Janeiro. In addition, there have



been 460 cases of dengue hemorrhagic fever, and 29 deaths in

the city as reported by Brazil’s municipal health authority. Dengue fever is commonly seen in Brazil, but these figures represent a significant increase in cases for Rio de Janeiro when compared to recent years. Many other countries in South and Central America and other tropical and subtropical regions of

the world are also reporting increased dengue activity. Disease surveillance efficacy varies from country to country and epidemics are not always reported in all countries. For this reason, travelers may not learn that a dengue epidemic is under way before they arrive at a particular destination. Source: *World Health Organization*.

Battle of Midway, Round Three

Midway Phoenix Corporation has closed its resort on historic Midway Island in the Pacific and all flights to the island have ceased ("The Battle of Midway, Round Two," April/May 1998). Midway Phoenix officials said the U.S. Fish and Wildlife Service had imposed "extreme" environmental policies and had in effect cut off tourist access to much of the atoll. With Midway's airport shut down, some airlines have had to shift their routes to comply with Federal Aviation Administration rules requiring that twin-engine airliners remain within 1,000 miles of an emergency landing site. The FWS is seeking another corporation to operate Midway's resort, food service, airport, and utilities.

Federal Aviation Administration registration records, Herrick has located nearly 20 of the airplanes—most were owned by corporations—that flew in the six Ford Air Tours. He owns one himself—a Paramount Cabinaire that flew in the 1930 tour. He wants to sign up about 25 aircraft and hopes many of the original airplanes will participate. If not, he knows enough owners of restored Ford Tri-motors, Stinsons, Wacos, Travel Airs, New Standards, and Eaglerocks who will gladly step in. Herrick is still hoping Ford and small airport operators will sponsor the three-week tour, which will land in most of the same 30-plus cities as the original tours and offer airplane rides at most stops.

"I want to re-create the circus-like atmosphere that existed at small airports around the nation," Herrick says. "Most people will probably never get to see some 25 vintage planes flying overhead ever again." For updates on the project, visit www.NationalAirTour.org.

—Doug Donovan

Clearing the Killing Ground

Richard Branson, founder of Virgin Atlantic Airlines, and QinetiQ, a research company in Farnborough, England, have created the Mineseeker Foundation, an organization that uses sophisticated ground-penetrating radar mounted on large airships to survey deserted battlefields for landmines and other unexploded ordnance.

QinetiQ has developed the Ultra Wide Band Synthetic Aperture Radar, which can locate objects as small as two inches, buried as deep as four inches. This system is mounted on an airship operated by the Lightship Group, a partnership between Virgin Lightships, a division of Branson's Virgin Group companies, and Lightship America, the operating division of American Blimp, manufacturer of the airships used by Virgin for advertising. The foundation hopes to deploy five airships worldwide to rid some 70 countries of a total of 60 to 70 million landmines. The United Nations estimates that 15,000 people are killed or injured each year by landmines or unexploded bombs.

The initial radar system was tested under the auspices of the United Nations Mine Action Coordination Centre in late 2000, when an airship with a similar system was flown over former battlegrounds in Kosovo. Over two months, the airship was used as a giant mobile antenna, allowing the radar to scan 119 square yards a second—compared to the 20 to 24 square yards per day that can be cleared by probing on the ground.

At the end of the exercise, involving 103 hours of surveying some 30 known minefields, the information was put on CDs and delivered to the Mine Action Coordination Centre. By the end of May 2001, a total of 10,000 square miles of land had been cleared in Kosovo, including more than 39,000 anti-personnel and anti-vehicle mines, cluster bombs, and other unexploded items. Originally, clearing Kosovo of mines was estimated to take 50 years.

"Many people thought we were crazy to take an airship into Kosovo," says Mineseeker project manager David Partridge. "But we proved it can be integrated." The airship also proved to be non-threatening, operating safely in an area where airplanes and helicopters routinely draw fire. Having proven the concept, Mineseeker Foundation is now trying to raise \$14 million to develop a more advanced Mineseeker II.

—Douglas Nelms



Greece: Due to parking restrictions, general aviation flights will not be allowed at



Rodos Diagoras International Airport (LGRP) during these set times until October 15:

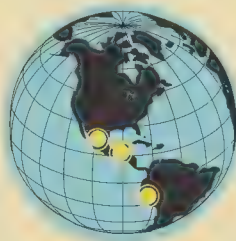
Wednesday from 0900–2359Z, Thursday from 0001–2100Z, and Sunday from 0400–2100Z. *Source: Universal Weather and Aviation*

Guatemala: Until further notice, Puerto Barrios Airport (MGPB) will be closed to international operations. In addition, all private and nonscheduled commercial aircraft

overflying or landing for commercial or noncommercial purposes must obtain prior permission from the Directorate General of Civil Aeronautics, La Aurora Airport, Zone 13, Guatemala City, Guatemala, at least 24 hours in advance. *Source: Universal Weather and Aviation*

Mexico: Mexican farmers released six

hostages they had taken on May 31 in the town of San Salvador Atenco, near



Mexico City. The farmers oppose plans to build a new airport in the area of Texcoco,

of which San Salvador Atenco is part. The hostages had been conducting a survey for the construction of three highways that are part of the airport project. The farmers oppose government attempts to expropriate land for building the new airport. *Source: Air Security Information*

Peru: There are indications that

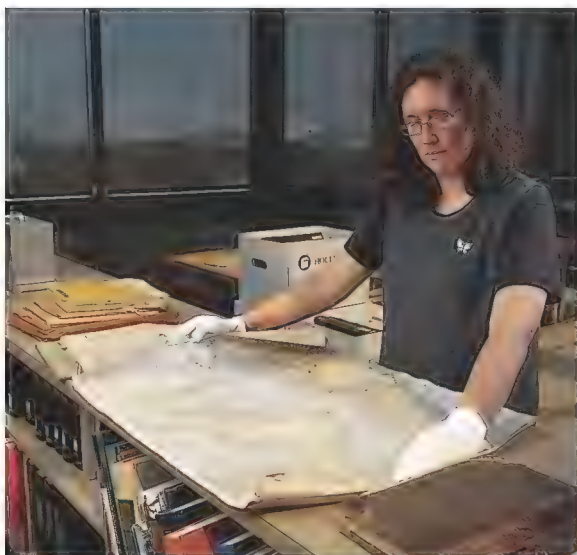
terrorist organizations are continuing to plan actions directed against U.S. citizens and interests in Peru. Travelers are advised to be vigilant and avoid crowds and public areas, particularly those areas where Americans are known to congregate. situation and exercise caution. *Source: U.S. State Department.*

The Papers of Crocker Snow

"Crocker Snow, now that's a Boston name," says Mark Kahn, a former Bostonian himself and currently an archivist at the Smithsonian's National Air and Space Museum. "I remember hearing about the battles over [the expansion of] Logan Airport in the 1970s. I was in high school at the time, and he was in the news." Kahn fingers the rough list the Museum has created of the contents of the Crocker Snow collection, which it acquired last summer.

Though Snow is not widely known in aviation beyond his native New England, his papers captivated NASM acquisitions archivist Patti Williams because the regional disputes Kahn remembers had national implications. "Crocker Snow was head of aviation in Massachusetts, and Massachusetts was one of the first [states] in the U.S. to have a major aviation bureau," says Williams. "He was deeply involved in how to manage a major urban airport," starting as early as 1939, when he became head of the state aeronautics commission. (Prior to 1939, the Motor Vehicles Department was in charge of all aviation-related issues and regulations.)

Archivist Patti Williams decided that a 1941 map on which Crocker Snow had marked proposed routes for World War II supply aircraft was worth adding to the Museum's collection.



ERIC LONG



COURTESY CROCKER SNOW JR.

In 1928, Crocker Snow (above) partnered with two friends to found Skyways, Incorporated, a company that transported passengers and sold airplanes.

Williams recalls the fall day in 2001 when Snow's son, Crocker Snow Jr., walked into the lobby of the Museum unannounced, with a copy of his father's biography, *Log Book: A Pilot's Life*. His father had died in 1999. Did the Smithsonian want his personal papers?

"Because I'm a staff of one, the families almost always have to contact me first," says Williams. "We only take about 40 percent of what we're offered. We have set acquisitions criteria. First, the papers must be of national, not just regional, importance."

She agreed to look at the collection.

Six months later, Williams flew to Ipswich, Massachusetts, to check out the various files, audio tapes, videotapes, photographs, and more stashed in the damp basement of Crocker Snow Sr.'s home. She spent the day sifting through the mementos and papers of a man whose life spanned the first century of aviation.

Born in Boston in 1906, Snow took his first flight with his older brother, Kick, in 1922, back in the days when airplanes braked by dragging their tail skids. He toyed with Harvard Law School for a year, but couldn't resist the allure of the airfield and the example of his charming brother, a former World War I pilot. Even after his brother died in 1923 while landing an airplane at the new Logan Airport, Snow remained convinced that aviation was his calling.

In 1928 he joined up with two well-off friends, Ted Kenyon and Andy Ivanoff, to

form Skyways, one of the first commercial flying operations at Logan. By the start of World War II, Snow had established himself as one of the most experienced and knowledgeable aviation figures on the East Coast.

During the war, the scope of his career expanded beyond New England. The U.S. Army Air Forces asked him to plot a northern polar path to Europe to be used in the event that Germany occupied the British Isles. He eventually established a variety of supply routes and oversaw the construction of bases and airstrips in places like Reykjavik, Iceland. He even saw action in the Pacific as commander of the first B-29s to bomb Tokyo.

Williams knew Snow's story by the time she started flipping through his filing cabinets in Ipswich. She also knew that the Museum would take something from his collection—the only question was what. On her second trip to Snow's home, she brought Dana Bell, a NASM information specialist. "You need someone with a knowledge of aviation history to sit in," says Bell. "What do we really want? On the surface everything is interesting, but we try to see where it would all fit."

Crocker Snow Jr. is grateful that his mother, Janice Snow, insisted the family keep certain items. "Dad's study still has all of the things that mean the most to the family, like his [first pilot's] license, which was signed by Orville Wright and is displayed on the wall." There were few dilemmas about what to give and what to

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keep. Mementos of interest primarily to the family, including the license, stayed. Documentation about Snow's World War II military career, including his service as commander of a provisional B-17 bomb group and his participation with the 498th Bomb Group, which flew B-29s, went. The Museum also collected documents regarding Skyways and reams and reams of reports and papers related to his work on the Massachusetts Aeronautics Commission and as a member of the Nixon administration's Federal Aviation Commission.

"Our collection is more technology based," says Williams. The bulk of what the archivists took "would be of interest to anyone interested in aviation law, and we don't have a lot of materials on that."

The end result: 40 cubic feet of materials stored in Building 10 at the Smithsonian's Paul E. Garber Preservation, Restoration and Storage Facility in Suitland, Maryland. It includes things like a 1980 environmental impact statement on the development of the Bird Island flats near Logan Airport and a 1941 map showing Snow's proposed flight routes for World War II supply aircraft marked in red grease pencil.

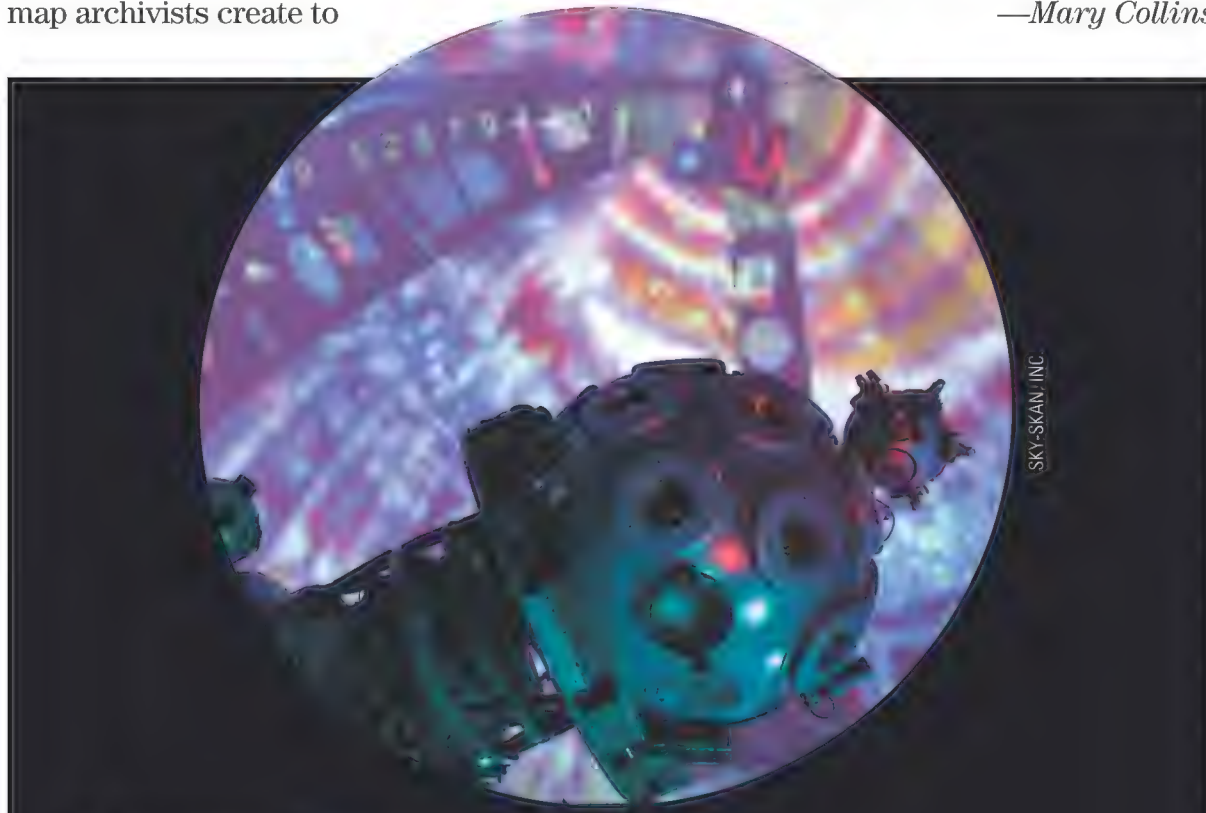
The Museum has still not created an official finder's guide—a road map archivists create to

help researchers navigate a collection—but the material in the boxes has some semblance of order, thanks, in part, to a friend of the Snow family who catalogued the files. (Researchers are permitted to access the collection at any time.)

In the end, the usefulness of a given collection could lie less with the facts than with its larger spirit. How can you classify observations such as this one, which Snow made in 1927 while making his first cross-country flight: "I navigated by dead reckoning. The cows, turning their behinds to the wind, showed me which direction it was blowing. Usually as I flew over cattle on their ranges, they barely budged. On this day, however, as I skimmed along at my customary low altitude, the cows scattered, startled by the noise of my plane. That meant I had strayed from my path: cows living on a direct course between cities were accustomed to airplanes."

When Snow died at age 94, he'd been involved in nearly every level of aviation since its infancy and had helped lay the framework for the busy urban airports of the 21st century. Along the way he also took time to savor the pleasures of low-altitude flights over farm fields, and that's Americana at its best.

—Mary Collins



The Planetarium's Makeover

After a one-month renovation, the National Air and Space Museum's Albert Einstein Planetarium is back—and better than before. The planetarium has gone digital, featuring a new technology that, in conjunction with the original Zeiss projector, uses 12 projectors to paint the entire surface of the 70-foot-high dome with images (above). The new technology gives viewers the sensations of three-dimensionality and movement. The latest show, "Infinity Express: A 20-Minute Tour of the Universe," takes advantage of the new system by transporting viewers on a wild ride through an enormous canyon on Mars and giving them a tour of the cosmos, in which thousands of galaxies float past. General admission is \$7.50; for more information, call (202) 357-2700.

Summer Hours From May 24 through September 2, the National Air and Space Museum is open from 9 a.m. to 5:30 p.m. General admission is free.

Location The Museum is located on the National Mall at 7th Street and Independence Avenue SW, Washington, D.C., just west of the U.S. Capitol building. The nearest Metrorail stations are L'Enfant Plaza and Smithsonian.

Food The recently renovated Wright Place restaurant now serves breakfast and lunch fare from McDonald's, Boston Market, and Donatos Pizzeria. The Wright Place is open weekdays from 7:30 a.m. to 5 p.m. and weekends from 9 a.m. to 5 p.m.

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Nights Over North Vietnam

Nguyen Cao Ky trained as a pilot in France and North Africa with Vietnam's army in 1951, and by 1964 he was named commander of South Vietnam's fledgling air force. The following year the army installed Ky as prime minister. He was the senior South Vietnamese official at the Paris Peace Talks. After the Communist victory in 1975, Ky went into exile in California, declining U.S. citizenship. Today, at 71, he sits on the boards of international corporations and consults with business and political leaders in Asia and the United States. This article is adapted from Buddha's Child: My Fight to Save Vietnam, Ky's autobiography, which he wrote with Martin J. Wolf, published last May by St. Martin's Press.

By 1960 there was an undeclared war between the two Vietnams. The Communists regularly sent intelligence agents and other infiltrators into the South, and because we had a relatively free society, many escaped detection. We, on the other hand, were getting no intelligence from the North. The U.S. Central Intelligence Agency proposed sending intelligence agents into North Vietnam using South Vietnamese airfields and aircraft.

I decided the best way to insert people

into the North from the air would be to come in at night from the sea, very low, under the enemy's naval radar, and follow a river up-country to the mountainous and relatively unpopulated border area, where the agents could parachute to the ground. A few instructors, Americans in civilian clothes, flew in from the States, and we started our night training, flying C-47s from Saigon to the mountainous region near Da Lat, about a hundred miles northeast. We did so well that after a few

days it was apparent that we didn't need U.S. help. The Americans went home, and after that, night after night, in any weather, we flew practice missions, following river beds through narrow mountain passes, learning to maneuver at low altitude in tight airspace at night.

Our objective was to drop small groups of agents with radios. After landing, they would disperse and take up residence in various towns. Once they were established, they could be used for almost any intelligence purpose or perhaps, eventually, as saboteurs. I didn't need to know much about that; my job was merely to deliver the agents to the North and get back undetected and in one piece.

Several weeks before the first mission I was introduced to William Colby, who was in charge of our mission (he would later become chief of the CIA). A compact, handsome fellow who spoke French but not Vietnamese, Colby was about 40. With thick eyeglasses and a disarming demeanor, he might have passed for an academic or an accountant. We became friends, often going out for dinner or a drink. As I came to know him better I realized that behind those glasses was a brilliant mind—he didn't miss much.

For the North Vietnam infiltration mission, the CIA built a scale model of the entire flight profile, complete with mountains, rivers, and bridges. This was to be a night mission, and there would be few landmarks visible along our route. Once we were inland, we had to fly by dead reckoning. That meant dividing the flight plan into segments of five minutes or so each, keeping very careful watch over airspeed, and making each planned course correction by the clock. We had nothing to enhance the pilot's night vision, and we didn't dare use lights in the cockpit, not even to read the map. I had to memorize every detail of the entire flight plan.

We moved to the Bien Hoa air base,



COURTESY GENERAL NGUYEN CAO KY

In 1965, five years after the C-47 low-level night missions, the author (circled) and his squadron were flying Douglas Skyraiders against the Viet Cong guerrillas.

north of Saigon. Upwards of 12 hours a day we practiced the navigation and the rest of the mission. During this training, as during the mission, the copilot and the navigator stood behind me, calling out the time in one-minute intervals. "Three minutes, two minutes, coming up on the turn of the river, 30 degrees left, one more minute..." I had to keep every detail in mind, and the other crew members also memorized the flight plan.

We went over it again and again, by day and night, sitting in a C-47 in a closed hangar. Even while I slept, the flight path was always in my mind: the map, the route, the elevation of surrounding terrain, how many minutes and how many seconds to fly at what speed for each leg of the flight, where the river turned, the locations of bridges, power lines, and other obstructions. Even now, I think I could fly most of that route without looking at a map.

On the day before the mission we flew to Danang, about 300 miles north of Saigon. After dark we went through a final check of our aircraft. As a full moon rose over the South China Sea, six or seven Vietnamese men in dark, nondescript farmers' clothing loaded equipment and parachutes into our ship, then climbed in. They were all volunteers, paid by the CIA and specially trained for this mission. It would be a long time before I knew much more than that about them.

Like our passengers, the air crew wore the black cotton pajamas of the Vietnamese peasant farmer. In our pockets were small sums of North Vietnamese money, North Vietnamese cigarettes, even North Vietnamese matches. If our plane went down over enemy territory, we needed to be able to blend in with the locals. But each of us also carried a hundred U.S. dollars, in case we had to bribe someone. (If we crashed, I could foresee no situation where we'd have time to use our parachutes. If we went down, we would be very lucky to have any use for currency or cigarettes.)

We took off from Danang, near the southern end of the Gulf of Tonkin, climbed to several thousand feet, then headed out to sea. Once we were out of sight of land, we descended, and when I could see white froth atop individual waves, I leveled off. We were two or three feet above the water at nearly 200 mph, and if enemy radar was pointed our way we hoped that our image would be lost in the clutter of the sea surface.

After heading east for several minutes, I brought the nose around to the left until it was pointed north by northwest, which took us straight for the mouth of the Red River. At Thanh Hoa we turned inland, crossing into North Vietnamese airspace.

Once inland, we followed the Red River. With the full moon behind me to

illuminate the landscape and no more worries about naval radar, I climbed just enough to avoid bridges and power lines. The land rose, the river valley narrowed, and the dark mountains loomed all around. With my copilot and navigator calling out course changes, we found the drop zone. As far as I could tell by moonlight, every parachute opened.

It was impossible that no one on the ground had heard us pass, but they had no time to react. If we returned the same way that we had come, however, the

As a full moon rose over the South China Sea, six or seven Vietnamese men in farmers' clothing loaded equipment and parachutes into our ship, then climbed in. They were all volunteers, paid by the CIA and specially trained for this mission. It would be a long time before I knew much more than that about them.

Communists would be waiting. So we continued west into Laos. Once out of North Vietnamese airspace I climbed to 12,000 feet, then flew south until we could turn east. Inside friendly airspace, I let the autopilot take over while we smoked a few cigarettes.

It was dawn when we landed in Saigon and taxied to an unmarked hangar. To my astonishment, Colby was waiting inside with a group of Americans and Vietnamese—and two cases of good French champagne.

After our second or third mission, Colby came to Tan Son Nhut with a delegation from Washington. They all wore civilian clothes; I assume they were CIA officials, there to observe how my pilots performed. Colby asked me to fly them from Saigon to Hue, and I did so in routine fashion. For the return trip, I gave them a taste of what their agents encountered. I flew out to sea, then turned south and descended until our prop blast blew foam off the wavetops. Then I pushed the throttles forward and flew at maximum speed. At this point, my crew later told me, all the Americans became very pale.

A few weeks later, in the afternoon of what was to be my third penetration mission, I went home to prepare for an 8 p.m. departure. I spotted Lieutenant Phan Thanh Van, one of my best pilots, in front of his apartment. Contrary to regulations, he usually flew bare chested to beat the heat, and rarely bothered with a safety belt. He invited me in for a drink, but I declined, explaining that I was flying that night.

"I'll go in your place," said Van. "I'd like to fly that mission tonight."

"If you want to take it, then go," I replied. About 1 a.m. the duty officer called me to the phone at the nightclub to say that the plane was missing and presumed down over the North. It would

be almost a decade before I learned that Van's plane had been shot down. When the aircraft hit the ground he was thrown through the cockpit window—and thus survived the fire that killed almost everyone else aboard.

Van's face was sliced up by windshield fragments, but Hanoi plastic surgeons restored much of his handsome visage. After his operation, however, he was locked up in Hoa Lo Prison, the infamous Hanoi Hilton. His flight engineer, the only other survivor of the mission, died

there. Van was freed after several years, and barely eked out a living doing menial work in Hanoi. Then a relative in France, working through the French ambassador, persuaded North Vietnam to allow him to emigrate to France.

Such eventual fortune, however, was not what was in store for the brave men we had delivered over the North. Every last one was picked up by the Communists, most within a few days of arrival. A few were shot, the rest imprisoned. Some spent over 30 years in confinement before they were released. The CIA had failed to note that virtually all North Vietnamese wear sandals. All the men that we dropped in wore shoes. We also failed to realize that in only five years the Communists had so thoroughly indoctrinated the people that subtle but telling disparities between Northerners and Southerners had appeared. There were differences in vocabulary and in the way people tendered pleasantries. Northerners even ate differently, using different condiments to season their soup and gripping their spoons with different fingers. Anyone not known to a particular small, insular community was immediately viewed with suspicion. The men we dropped in towns or villages were soon spotted as outsiders.

We made mistakes, and these cost men their lives or their liberty. Nevertheless, we were fighting a war. We had to try to get intelligence, even at the sacrifice of dozens of men. I think the agents understood this. Most survived their captivity, and when they were finally released in 1995 the U.S. government gave each of them a settlement of \$50,000. There could never be enough money to repay them for their suffering, but besides the money they were welcome to live in the United States if they so chose. I believe every one of them left Vietnam.

Kid Stuff

The Beechcraft King Air 200 has shut down, the passengers have disembarked, and as the pilots are walking away I whisper into my young son's ear, "Wave at the pilots." It works like a charm. One of them walks over and asks Tudor, "Would you like to see the inside of this airplane?" "Yesssirr!" he shouts. In we go. Tudor goes for the left seat. I have my camera ready and snap another photo for his collection.

Airplanes have always fascinated me. Growing up, I wanted to fly F-4s for the Navy. I watched the Blue Angels every year at Belle Chasse Naval Air Station in New Orleans, and I was sure that one day I too would be signing autographs for adoring kids. I learned how to fly when I was a senior in high school. I was a good pilot, able to make soft-field landings and smooth turns in Piper Tomahawks and Cessna 152s. There was only one problem with my piloting skills: I was a lousy navigator. I made two cross-country flights, and on both I got lost. Only a low pass over a town-labeled water tower saved me.

In college I had several meetings with Navy recruiters. While watching their films, I could picture myself hopelessly lost over the Pacific, with the back-seater hollering, "The carrier's east! Don't you know which way is east?"

Fast-forward about 20 years: One day I decided to bring Tudor to the Greenville Downtown Airport in South Carolina to watch airplanes. It's a great general aviation airport with a four-foot-high wall separating the parking lot from the

taxiways. The first day that Tudor and I had seated ourselves on the wall, the pilot of a Cessna Citation II business jet walked up and asked if my little boy would like to go inside. "Hell yeah I would!—uh, I mean, yes, of course, right, son?" While Tudor tried to twist the yoke off the panel, the pilot entertained my questions about rotation speed and maximum thrust.

Driving home, I realized this never would have happened had I been by myself or with someone my own age. It was definitely the kid. Most of us are only too happy to show off where we work to a starry-eyed child, and pilots are no exception. It took several more experiments before I could prove my theory.

The next week, there we were on the wall waving at pilots, and sure enough, we got invited into a Beechjet. A couple of weeks later we got ushered into a Cessna 421, and a few weeks after that, during a trip to Louisville, Kentucky, Tudor got to sit in a Eurocopter Dauphin air ambulance. Much to my wife's dismay, he told her the story of Pilot Glen and Nurse Patsy's Dauphin over and over, all the while flying the

toy helicopter I had bought him in Louisville.

When we were invited into a Canadair



Malik & Son most recently wangled a tour of a Sikorsky MH-53.



The author's son Tudor is like a boarding pass for all sorts of exotic aircraft.

COURTESY JOHN MALIK; TOP: USAF

Challenger, I knew my theory was valid. The next day, Tudor was looking at photos of the space shuttle and asked me if one day we could see the shuttle take off. "What a great idea! Of course we can," I replied. "Will the astronauts let me sit in the cockpit?" he asked. *Hmmm, I thought, I wonder if we could pull that off.*

"You're giving him a false sense of reality," my wife complained. "No I'm not, it's all part of my plan," I told her. I confessed I was trying to mold our son into a fighter pilot or a shuttle commander.

"You know, it wouldn't hurt to take him to an art museum once in a while," she said. "I've got no problem with that," I told her. "Why don't you see if he can find the museum by dead reckoning?"

I truly believe I can work all of this to my—uh, his—advantage. If the early years are the formative ones, my son is well on his way to becoming a Blue Angel or a shuttle pilot, circa 2027. I wonder if the Blue Angels' parents ever get asked for autographs. Or better yet, maybe the fathers of shuttle commanders get to sit in the cockpit.

—John Malik

A close-up, high-angle photograph of a luxury chronograph watch. The watch features a round, polished metal case with three prominent blue gemstones (likely sapphires) set into the top bezel. The dial is white with a fine, textured pattern and is adorned with gold-toned Roman numeral hour markers. It includes three sub-dials: a 60-minute counter at 9 o'clock, a 12-hour counter at 6 o'clock, and a 30-second counter at 3 o'clock. A date window at the 3 o'clock position displays the number '14'. The brand name 'KLAUS ROBBE' and 'OUTURE SPORTS' are printed on the dial. The watch is fitted with a two-tone metal bracelet, featuring gold-toned and silver-toned links. The background is a blurred, light-colored surface.

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They're not as fast as the top Unlimiteds, but the national air racing organization is gambling on

L-39 Albatros jet trainers scream around the pylons in a trial race in June 2001. Will the whine of turbofans overtake the thunder of Mertins as Reno's big draw?



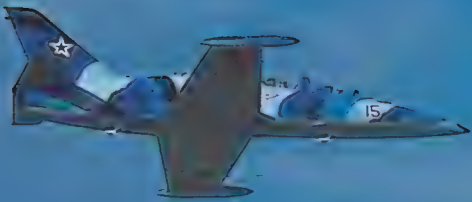
RENO ENTERS

THE

>>>> by Carl Hoffman

JET

AGE



jets to boost attendance. >>>> Photographs by

Richard Vander Meulen



Race officials see the L-39 as a sort of jet racer on training wheels: well behaved and slow enough to stay within the somewhat cramped course. It's also abundant.

“Look,” says Don Kirlin, opening the forward avionics compartment of an Aero Vodochody L-39 Albatros that not long ago prowled the skies over the former Soviet republic of Kyrgyzstan. The narrow space in the jet’s nose once held 700 pounds of avionics but now is empty. “We took an area that was used for targeting weapons and you can now haul two sets of golf clubs!” crows Kirlin, the United States’ largest importer of L-39s. “And,” he says, like a born salesman, “you could put it right down on the fairway!”

This former Eastern Bloc trainer and attack jet is not being prepped for a day on the links. It’s about to star in pylon air racing. In September seven L-39s will compete in the first jet-class race at the National Championship Air Races in Reno, Nevada. It is the latest in a series of moves to keep the world’s fastest motorsport from going the way of the drive-in movie. The sheer improbability of Kirlin’s sales pitch speaks volumes about how much times have changed and the long-maligned way

the former Soviet bloc designed and built airplanes.

When Roscoe Turner and Jimmy Doolittle cranked around the pylons in the late 1920s and early 1930s, they did so in cutting-edge technology. Their machines were among the fastest in the air, including the military’s. When 100,000 fans crowded the National Air Races at Cleveland in 1929, they were treated to the best pilots flying the world’s hottest aircraft, and Doolittle and Turner became household names. In recent years, however, Reno has become a mere vestige of that era, a showcase of arguably irrelevant technology. The marquee event, the Unlimited class, features World War II airplanes that haven’t seen active service in the lifetimes of anyone born after 1950 and whose speeds haven’t increased in two decades. A Bearcat or Mustang may bring tears to the eyes of a man or woman of a certain age, but for legions of people born after World War II, it’s just another antique. The race is won year after year by the same handful of airplanes that are 100 mph faster than

most of their competitors. And consider the sheer expense: a million or more for a Mustang or Bearcat, \$200,000 for an engine that might not last the first lap, thousands more for fuel and parts. "The Unlimiteds are just so expensive and the engine builders are getting scarcer," says longtime Unlimited racer Jimmy Leeward. "You can only afford to run a *Dago Red* or *Rare Bear* once a year," says Skip Holm, 2000's Gold Unlimited winner. "If you break 'em, it takes a year just to fix 'em. If NASCAR had only one race a year, it wouldn't have many fans. It's amazing that Reno can get anyone at all to come!"

For a while it almost couldn't. "Racing alone wasn't paying the bills, and four years ago we were as close to shutting down as is possible," says Michael Houghton, president of the Reno Air Racing Association. In debt and faced with declining attendance, the races had to make a decision: It was adapt or die, says Houghton, "and we made a commitment to turn it around. We're in show business, and we have to put on an entertaining event for the broadest number of people. We talked to our crowd and they told us they wanted to see some new things take place."

First, Reno beefed up the airshow portion of the event, increasing its static displays and adding flying performances between every race. In 1998 it introduced the Sport class (see "Back in the Race," Aug./Sept. 2000). The class was open to production model kit-built aircraft, one of the fastest growing seg-

Mary Dilda was the first woman to win a national air race (T-6 class, 1997). She likewise creamed the competition at an L-39 trial race last year.



Albatros, Mustangs, T-6s, or Lancairs—Reno's high desert is an air racer's dream. But the wide open space is threatened as developers build ever closer. The air races may eventually have to find a new home on the range.

ments of general aviation, and it was hoped that a NASCAR-like battle between factory-sponsored teams would develop as racers flew airplanes that John Doe in the stands could afford to own and fly.

Reno was getting exciting again. From a low of 120,000 spectators in the mid-1990s, attendance rose 60 percent in 2000 to 189,000. Still, there remained one type of aircraft conspicuously absent from the course: jet warbirds. Reno might be the last great piston show, "but if we're going to keep racing we have to increase the appeal of the venue, and kids identify with jets, not Mustangs," says Rick Vandam,

Reno's air boss and director of operations. The race organizers wondered if recapturing Reno's former glory would require racing a new class of aircraft.

At the 2000 races the word went out to the crowd: After the climactic Gold Unlimited race on Sunday afternoon, there'd be an exhibition jet race. Would the crowd stick around to watch?

Late on Sunday, three MiG-17s (one flown by Leeward), an L-39 flown by Rick Vandam, and a T-33 screamed onto the course. The -17 pilots had been explicitly forbidden by the Federal Aviation Administration to fire the afterburners. But you can't handicap a good racer. After four laps Leeward was at the back of the pack, and, unable to help himself, he lit the burners. Another -17 pilot did likewise. The sound was deafening as Leeward shot well over 500 mph for the two final laps to win. The crowd in the stands went nuts, hooting and cheering. Even Merlin engine poster boy Skip Holm "found it real exciting," he admits. Reno had passed out surveys to the crowd and the final word was unanimous. Bring on the jets.

There was only one problem. The kind of free-for-all that made the exhibition race—and the premier Unlimited class—fast and exciting seemed impossible with military jets. The fastest, highly modified Mustangs, Bearcats, and Sea Furies are all closely matched





So much for "You've gotta have heart." Dilda's Albatros carries a more aggressive moniker than her T-6 Two of Hearts.

in performance and, barring a technological breakthrough, are hard put to break 500 mph doing laps. But jets come in all shapes and sizes, from straight wing to swept wing, some with afterburner and some without. The speed difference between an Aero Vodochody L-39 and a MiG-15 or F-86 is nearly 300 mph. "We couldn't figure

out a way to make it a fair race," says Bill Eck, chairman of the Reno Air Racing Association.

Competition issues aside, the FAA gets goosebumps at the idea of civilians operating military jets anywhere, let alone on a nine-mile race course originally designed for lap speeds of 450 mph and surrounded by houses on

three sides and 50,000 people on the fourth. The agency is still haunted by what Vandam calls "the Farrell's ice cream store incident." In 1972, a civilian-operated F-86 slammed into Farrell's Ice Cream Parlor in Sacramento, California, killing 22 people, including 12 children. When Vandam brought up racing jets to the FAA, "they immediately brought up Farrell's," he says. Although course modifications allowed speeds of up to 550 mph, says Clarence Bohartz, FAA flight standards and operations inspector at Reno, that still wasn't fast enough for afterburning, swept-wing jets like MiG-17s and F-86Ds. Indeed, Vandam has flown the course at 570 mph in a MiG-17, and he says, "It's very difficult to stay within its confines."

Still another problem was image. Jet fighters though they were, Sabres, MiG-15s and -17s, T-33s, and most of the other likely airplanes available looked old, just when Reno was trying to look new. "They say 'Korea,'" says Holm. What Reno needed seemed impossibly contradictory: a jet fighter whose sleek lines raised your adrenaline, but wasn't too fast or unstable; one that looked modern, but didn't require a national budget to own or operate. And there had to be enough

Longtime air racer and former astronaut Hoot Gibson (left) tells it to the hand of Unlimited racer Jimmy Leeward at jet trials in 2001.





CAROLINE SHEEN

One of Reno's most coveted prizes is a pit pass, which allows the audience to get up close and personal with the musclebound Unlimiteds.

of them to draw a racing field year after year.

The L-39 Albatros might have been custom designed for those requirements. In the exotic zoo of warbirds becoming available to civilians, the Czechoslovakian-made airplane exemplified all the best characteristics of the Eastern Bloc. "The L-39 was designed to be operated well in some awful place without a paved runway by an 18-year-old with nothing but a toolbox and who may not be able to read," says Don Kirlin. A 737 captain for US Airways and ex-Navy pilot who is vocal in his love of speed and performance, Kirlin has imported 50 of the 197 L-39s registered by the FAA. His latest arrivals, a shipment from Kyrgyzstan and Ukraine, stand in various states of repair in his hangar in Quincy, Illinois, a Midwestern monument to the airplanes and air forces that just last week, it seems, were U.S. adversaries. (Across the runway in another hangar perch his two MiG-29s.) Some rest wingless in their shipping fixtures, while others, in weathered camouflage, look like they had yesterday been poised on a Central Asia flightline. "They look bad," says Kirlin, "but that's just because they've been outside their whole life. They have really low flight time."

Eastern Bloc airplanes are often derided as crude, but Kirlin is quick to extol their virtues. "You look at these planes and you so value their designers' thinking; they're so simple and robust," he says.

As a jet trainer the Albatros is easy to fly; the Soviets were known to solo pilots in the airplane with as little as 20 hours of total time. As a light attack jet it was meant to be operated on the front lines from Siberia to Central Asia, so it can take off on dirt runways in 1,500 feet and land in 2,000. It has stout landing gear and balloon tires suitable for landing on your average East German wheat field or American country club fairway. It is simply built and simple to maintain, with color-coded plumbing, for instance. A late-model airplane equipped with a 3,800-pound-thrust turbofan engine, it uses a mere 145 gallons of fuel an hour, less than half what an F-86, T-33, or MiG-17 uses. To start a MiG requires a bulky auxiliary power unit "and a lot of praying," says Kirlin; an Albatros carries a self-starting APU. And the Albatros is no Yugo. With a top speed of 485 mph at 19,000 feet, a ceiling of 36,100 feet, and a fully aerobatic airframe, the L-39 performs like a thoroughbred.

"It's the highest quality aircraft of its

type," says Gary Dyer, a recently retired 747 captain who took a ride in one at Reno a few years back and promptly bought one for himself, which he is loaning to the race. "It's modern. Reliable. Pressurized. Rugged and low-cost, with air conditioning and anti-skid brakes. It's the plane the Eastern Bloc used to train pilots who had never before flown before putting them in a MiG-21. I can do a little sightseeing and a little aerobatics in it."

"It is a hot little airplane," Kirlin says, "but it's as close to pilot-proof as can be." At Mach .78, speed brakes automatically deploy. At 176 mph, the flaps automatically retract. Still, says Kirlin, "when you've got your hands on the throttle and stick, you know you've got something serious under you."

All true, says Tom Rowe, whose Phoenix, Arizona-based Worldwide Warbirds has imported 15 L-39s in the last year, "but every L-39 owner will tell you the planes go faster and burn less fuel than they really do! It's funny. The planes have the highest uptime of any military training jet ever built and they're unequalled in many ways, but they're not rocket ships. There are other aircraft out there that are close to them in price that perform better, but aren't air-conditioned or



In the 1970s, the L-39 was the standard jet trainer for the Soviet Union and Warsaw Pact countries. The Russian Knights demo team once flew them.



pressurized. And you've got to be careful, because a lot of the early C models have spent a lot of time sitting in a field somewhere and they require a heck of a lot of work."

With nearly 3,000 manufactured and used everywhere from Afghanistan to Iraq, they and their parts remain plentiful and cheap. Even after they have been overhauled, painted, and loaded with new Western avionics, Kirlin sells his Albatroses for only \$200,000 to \$400,000. "You can get one for half the cost of a new Bonanza," he says.

"Bingo! It hit me," says Rick Vandam, who was friends with Kirlin and others with L-39s. "The Albatros fit perfectly. Availability, looks, simplicity. It's such an easy airplane to fly, which means we could feature some of the top pilots and see who flies the best."

Both to placate the FAA and to "put the personalities in front of the crowd, rather than the airplanes," in the words of Houghton, Reno invited veterans of racing and high-performance fighters to fly the first race last September 13. It became one of the many events cancelled by the upheaval of September 11. This year, Unlimited racers Skip Holm and Jimmy Leeward, AT-6 champion Mary Dilda, former astronauts Hoot Gibson and Curt Brown, and Sport class president and former Navy F-4 pilot Lee Behel will race in identical L-39s on loan from various owners. The pilots' starting positions will be determined by a random drawing before each race, and they'll get points based on their finishing positions and the number of times they pass competitors. Adding to the novelty, the pilots' pre-race briefing will be conducted in public. "We want to focus on the pilots instead of planes like *Rare Bear* or *Strega*," says Vandam.

For the first time at Reno, blowing an engine won't be a problem. An L-39 will be race-ready the moment it hits Stead Field, and it will be able to run all day with hardly a burp. "It's so much more reliable and easy to fly," says Leeward. "You're never operating out of

At Reno's 2001 pylon racing school, pilots assemble with (left to right) a Cassutt, a highly modified Mustang, an L-39, a T-6, and a Questair Venture.



The L-39 (above) had no trouble negotiating the tight nine-mile course at the trials. MiG-17s, faster and heavier, sometimes ran out of bounds.

the envelope and you're not waiting for technical problems or an engine to quit. And the cost is affordable."

"L-39s are responsive and a little underpowered," says Dilda, a DC-10 captain for Federal Express. Because coming around the pylons bleeds off airspeed and the Albatros has no afterburner, there's no way to accelerate quickly, and that, Dilda says, "will make it a real pilot's race."

Holm agrees. Although Unlimited pilots like him and Leeward have more experience flying the course at high speeds than T-6 and Sport class vets like Dilda and Behel, the 400-odd-mph lap speeds won't be as high as that of the fastest Unlimiteds. "If we were flying 100 mph faster, I'd have a real advantage," he says, "but at that speed the people flying 'em will figure it out real quick." With equally matched airplanes in the hands of skilled pilots, Reno wants a close race of bunched racers duking it out at high speeds.

But are L-39s the future of air racing? Even some of the jet class racers themselves wonder whether the very elements that make the L-39 such an acceptable race airplane will make the event more show and less edge-of-your-seat race. After all, part of the thrill of Unlimited racing is the knowledge that a *Strega* or *Dago Red* is a rare, million-

dollar beast flying at the very edge of stability, and that at any moment the finely tuned pistons hammering at pressures unimagined by the original designers might explode in catastrophic failure. Is flying a quiet, pressurized, reliable, air-conditioned airplane exciting enough to satiate a crowd that lives for fire and noise and engine builders with the skill of magicians? "A Gold racer is like pure adrenaline," confesses Holm, "and an L-39 is nothing like a Gold racer. It's the difference between a VW and a Ferrari Testarossa. That extra 100 mph and 80 inches of manifold pressure is what makes 'em come to life. If you can't run an Unlimited Gold racer, then Reno loses its appeal for me."


But some hope that ultimately, the tame L-39s will be superseded by a wilder generation of jets. To match the heady romance of noise and heat and danger with jets would require an Unlimited jet race, with pilots flying on the edge whatever they brought to the course. It's a compelling proposition, and one that everyone knows would recapture the glory days of cutting-edge air racing. That remains a dream to many who prowl the pits of the air races, a dream that will move one step closer to realization if the first jet races come off without incident. "It's a possibility," says

Houghton. "It might work," says Vandam, "but first we'll have to prove we can come out and fly jets safely." Whoa, says the FAA's Clarence Bohartz. "I've already got my neck stuck out! That's way down the road, and for that you'd need a race course that takes up half the U.S.!" Reno, at any rate, seems ready to push the envelope. ➔

Racer Lee Behel, the start-up guy for the 1998 debut of the Sport class, will fly an L-39 this year.



It couldn't last forever. In fact, it was supposed to have ended a long time ago. Galileo, the first spacecraft to orbit any of the large planets beyond Mars, may have been the most delayed mission in NASA's history. It was originally scheduled to launch in 1982, reach Jupiter three years later, and wrap up by 1987. But a series of setbacks with the space shuttle and Galileo's attached booster rocket pushed the launch to 1989 and arrival to 1995. Although the looping tour through the Jovian system was planned to end two years later, Galileo's mission was extended twice so scientists could get closer pictures of Europa, with its iced-over ocean, and the other large satellites: Io, Ganymede, and Callisto. Now at last, the end is near. In September 2003, with hardly any maneuvering fuel left, Galileo will end its last orbit with a plunge into Jupiter's atmosphere.



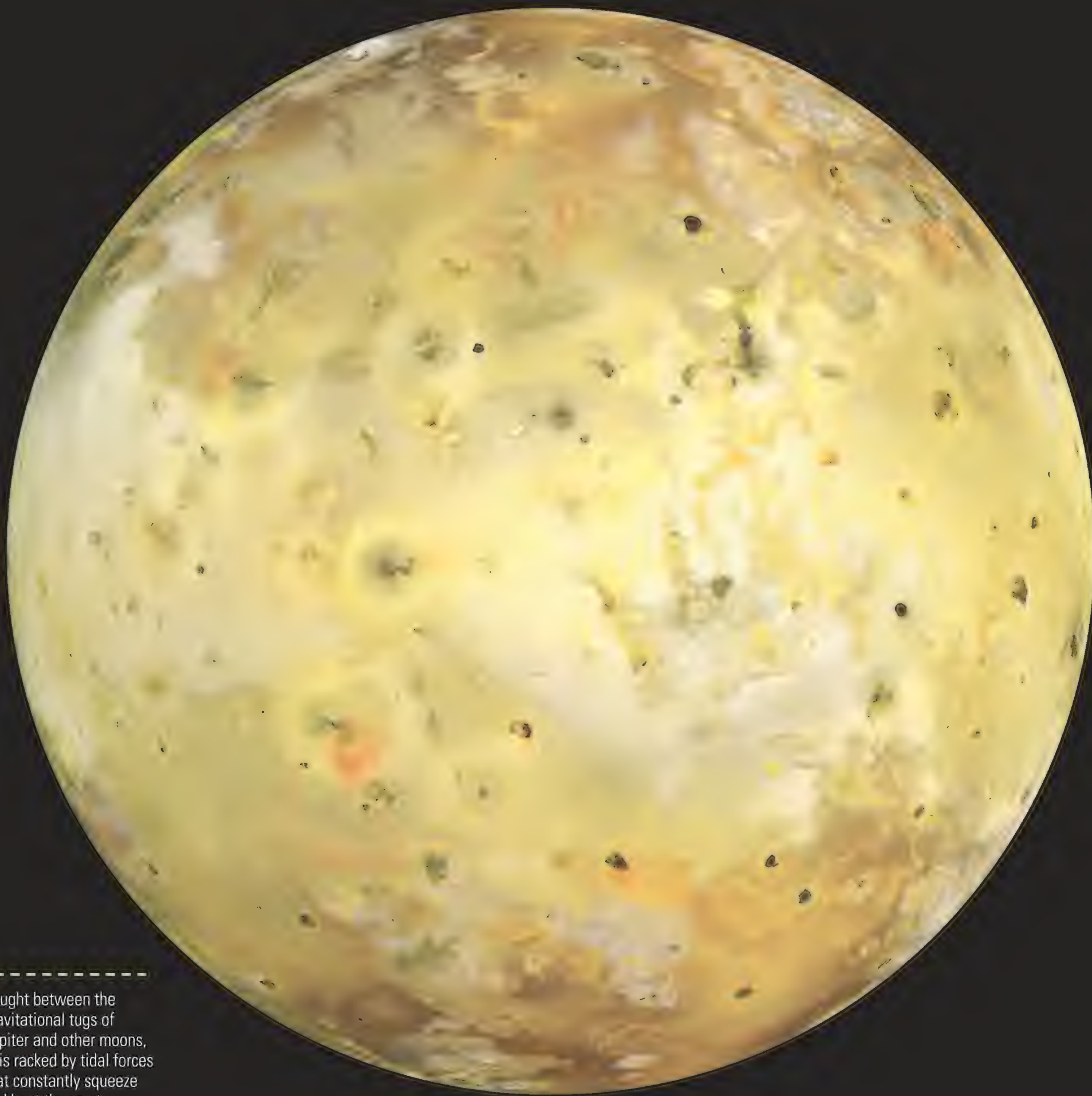
Tohil Mons, a 19,700-foot-high mountain, is at the center of this mosaic of images taken during Galileo's close flyby of Io on October 16, 2001. One of the highest-resolution pictures taken during the six-year mission, the scene shows details measuring as little as 160 feet. Flanking the mountain are two paterae, or volcanic craters, with a web-like pattern of lava flows visible at the upper right. Galileo tried to take another round of pictures of Io in January, but the blistering radiation near Jupiter caused the spacecraft to shut down temporarily.

by Tony Reichhardt

GALILEO'S

Launched
13 years ago, a
rugged spacecraft
sends its last
postcards from
Jupiter.

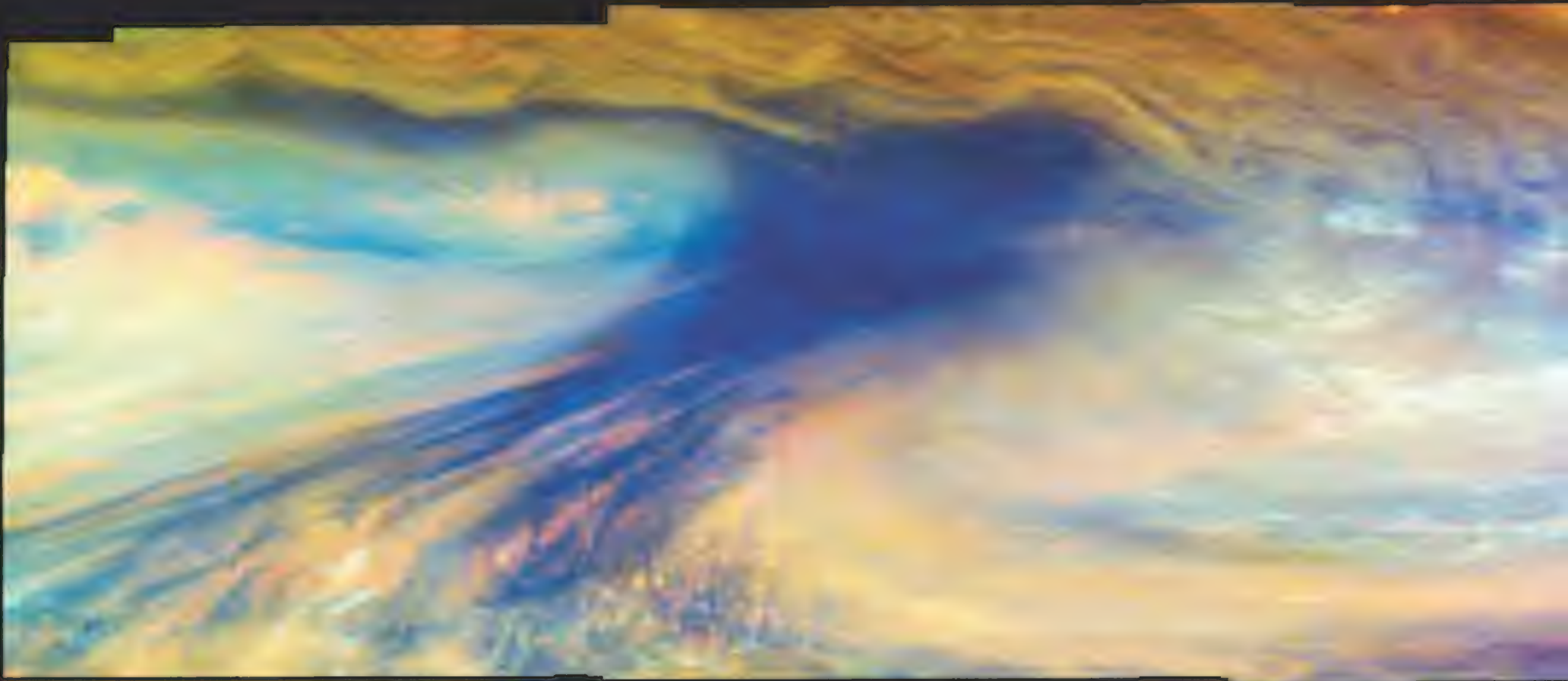
ALL PHOTOGRAPHS: NASA



Caught between the gravitational tugs of Jupiter and other moons, Io is racked by tidal forces that constantly squeeze and heat the crust, producing volcanoes—lots of them. The moon's mottled coloring comes from different minerals erupting onto the surface.

LAST LOOK





Jupiter's turbulent atmosphere, as seen in natural color (top) and false color. At near-infrared wavelengths (above), the cloud layers appear more distinct. Bluish clouds are high and thin, reddish

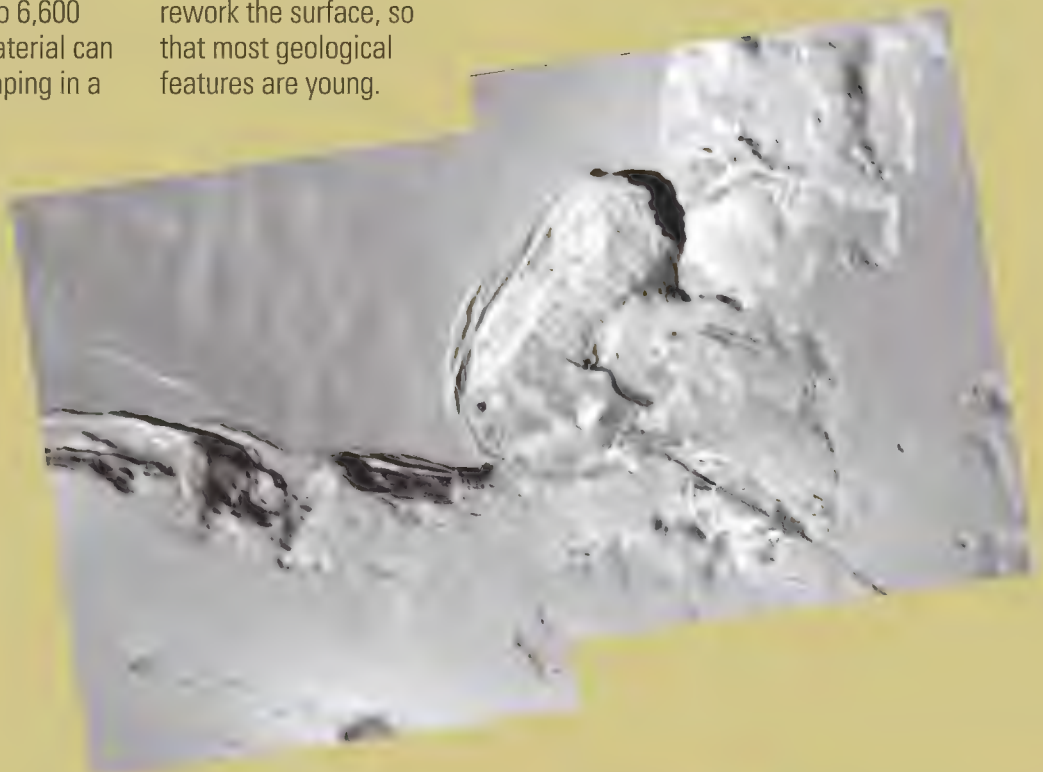
clouds are low, and white clouds are high and thick. This image of a "hotspot" near the equator covers an area about 21,100 by 6,800 miles. Galileo's photos were the first to show different cloud layers on Jupiter.





A remarkable closeup of Io, taken by Galileo last October (below), shows an eroded cliff (the amphitheater-shaped structure at the center) estimated to be 3,300 to 6,600 feet high. Material can be seen slumping in a

southeast direction from the sharp edge of the cliff—the legacy of past erosion on a world where volcanism and lava flows continually rework the surface, so that most geological features are young.



When the spacecraft's namesake, Galileo Galilei, first trained his telescope on Jupiter in 1610, he saw only four moons: Io, Europa, Ganymede, and Callisto (arranged in this artificial montage from top to bottom). Now astronomers count 39. Yet the objects of greatest interest continue to be the Galilean moons. Even Earth-based telescopes show the planet's Great Red Spot, the most prominent storm on the planet. It has persisted for at least 300 years, with winds blowing counterclockwise around the center at 250 mph.



Shooting from a distance of 1.4 million miles, Galileo's digital camera needed four frames to capture this elegant mosaic view of Jupiter's thin ring system, made of dust particles (opposite, bottom). The pictures

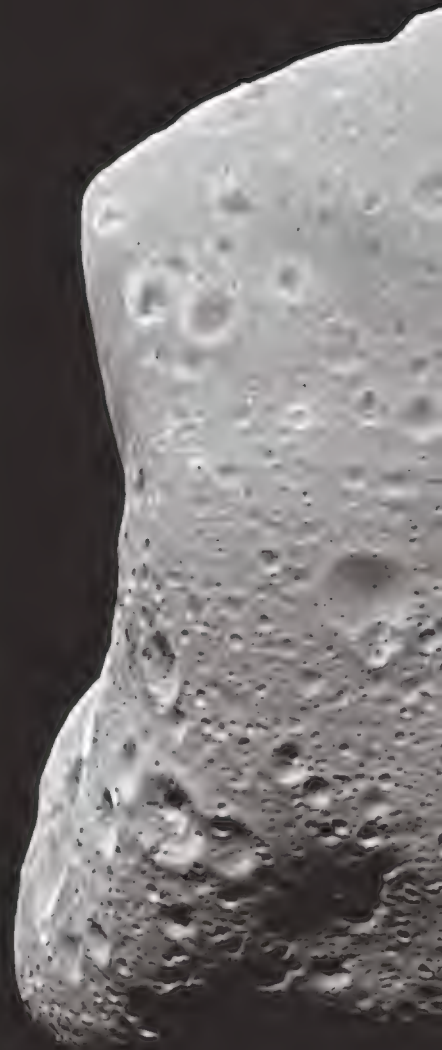
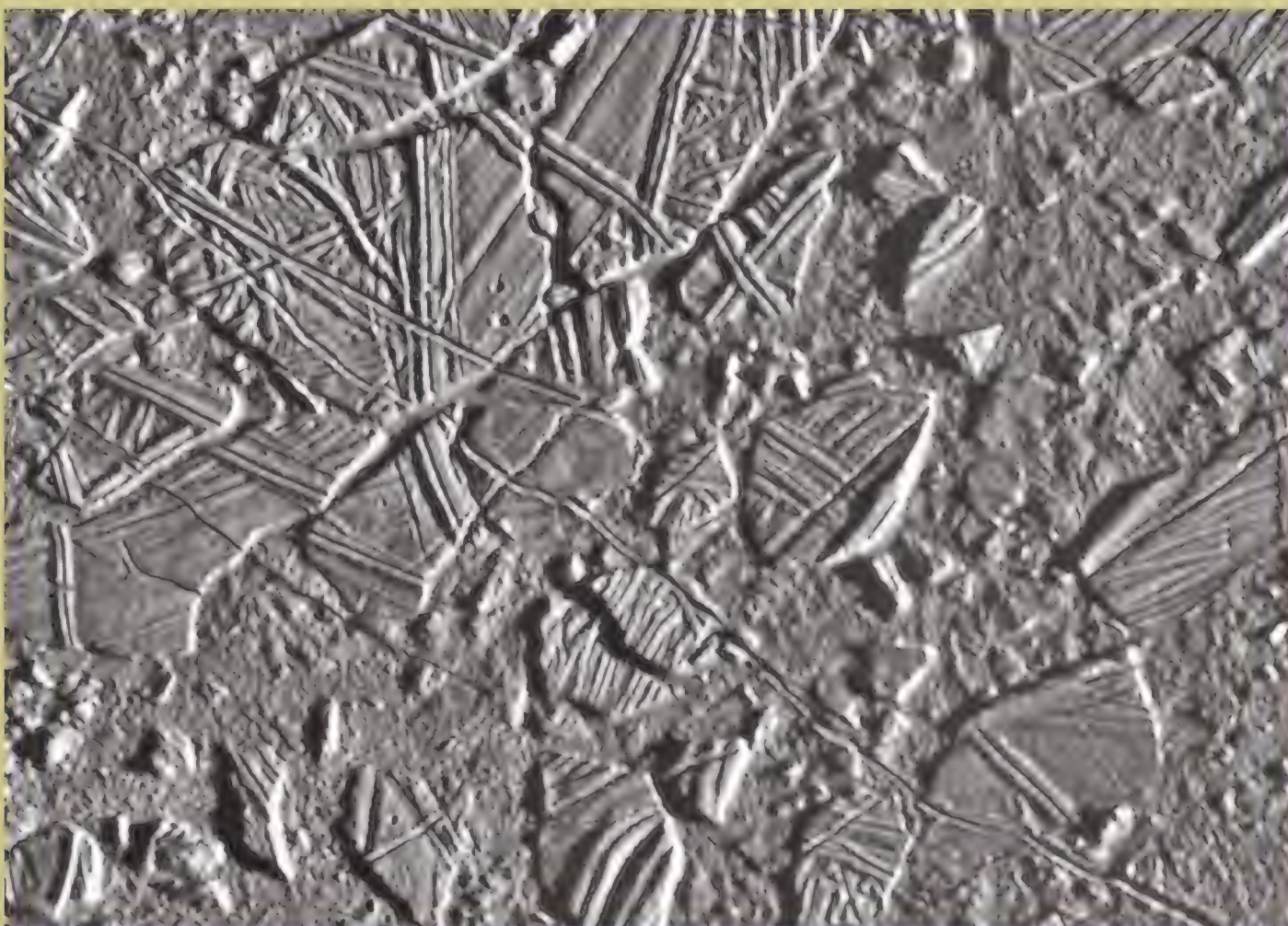
were taken in November 1996, when the spacecraft was in Jupiter's shadow, looking back toward the sun. The arc at right is due to sunlight scattered by small particles in the planet's atmosphere.



Even before Galileo arrived at Jupiter, scientists had speculated that a liquid ocean lies underneath Europa's cracked, icy crust (left). High-resolution photographs taken by Galileo in February 1997 all but settled the matter. The lines in this image are cracks in the ice where the surface has shifted—the reddish tint is a result of contaminants in the ice. Scientists have now advanced the argument from whether there is an ocean to how deep it lies, and whether life exists there. NASA is making long-term plans for a Europa orbiter to take the investigation further.

The key pieces of evidence in nailing down the presence of an ocean on Europa were Galileo's high-resolution pictures of "rafts" of ice (below) that shift over time. The size and orientation of these

rafts, which typically are miles across, suggest that they float on liquid or soft ice, then refreeze in a new place (see "Surfing the Solar System," Dec. 1997/Jan. 1998). The area shown here is about 21 by 26 miles.





Because Galileo had to cross through the asteroid belt on its way to the outer solar system, mission managers were able to chalk up another first. After years of guessing what the surface of an asteroid

looks like, Galileo delivered to astronomers the first closeups of Gaspra (the smaller object) and Ida in October 1991 and August 1993, respectively. Both asteroids proved to be irregularly shaped

rocks, and Galileo discovered a tiny moon, Dactyl, circling Ida. The 10-mile-long Gaspra was photographed from a distance of 3,300 miles, and the 35-mile-long Ida from around 2,200 miles.

Galileo took this backward-glance photo of Earth and its moon from 3.9 million miles away, just eight days after the spacecraft made its second swing past Earth, in early December 1992.



THE UNEMPL

WHERE AIRLINERS GO WHEN THEY'RE OUT OF WORK.



AL SHARIF PULLS HIS ASHTRAY-SCENTED sedan over to the side of the ramp and parks. "I call this place Alcoa," he says, blowing a jet of smoke through his open window and into the mild desert air.

Just beyond the car lies a hobbled early-series Boeing 737; its landing gear struts have been stripped off, and it's been left to totter ignobly on its belly. Further on sits a fuselage from some wide-body, neatly scythed up like a piece of summer sausage, with seats and overhead baggage bins still in place.

A piece of machinery that would look at home sinking trenches clatters up to the fuselage of a DC-10 and, with a mechanical

claw, begins tearing into the smooth skin as easily as if it were made of foil. Nearby, another machine, with an arm wielding what appears to be the world's largest bolt cutters, works over a portion of a wing. As we watch, the machine snaps through a stringer, producing a loud *thock*. Sharif chuckles and turns to me. "Pretty cool, huh?" he asks.

For most of the great airplanes, this is the way the world ends, not with a bang (thankfully) but routinely, beneath chromium blue desert skies.

Watching the scene, I'm reminded of the time I stood on the Las Vegas strip to toast the destruction of the landmark Sands

OYMENT LINE

BY HOWARD STANSFIELD PHOTOGRAPHS BY ETIENNE DE MALGLAIVE



Grounded by a slowing economy and the aftermath of September 11, hundreds of airplanes hibernate in a storage yard in Mojave, California.

Hotel & Casino. As the demolition charges rippled through the building like a string of firecrackers, another of the grand dames of the Vegas skyline vanished from the earth, the victim of obsolescence and changing tastes. Commercial jetliners occupy a similarly rarefied niche. Jets are among our most enduring icons of progress, modernity, and escape. Yet despite the meanings we have attached to them, they, like casinos, are also just simple commodities. The jets arrayed before us have had every last ounce of value wrung

out of them, and all they're worth now is the scrap value of their aluminum hulls (about \$30,000 for a 747, Sharif tells me).

This is one solution to "excess fleet capacity"—an industry euphemism for too many seats for too few butts—and it's what I've come to see on this pleasant spring morning at the Evergreen Air Center: what happens when airlines cut flights by 20 percent, the result of an economic slowdown and the kick in the industry's groin delivered on September 11.

Set amid the gray-green creosote and

Airliners far from
the bustling ramps
at busy airports
seem incongruous
here, with their
silent engines, foil
covers, and
wrapped tires and
windows.





MATT YORK / AP/WIDE WORLD PHOTOS

At Evergreen Air Center in Arizona, 747s rub shoulders with smaller jets waiting for jobs. Opposite: A jumbo stored at the 5,000-acre airport in Victorville, California, appears to be leading a gaggle of 727s out of the desert, but for now these airplanes are going nowhere.

mesquite 50 miles northeast of Tucson, Evergreen is one of a handful of dry-climate MROs—maintenance/repair organizations—qualified to perform heavy maintenance on big jets. Sharif is Evergreen's manager of heavy maintenance sales. Lately, though, maintenance has been on the wane, while the centers' other functions—storage and scrapping—have spiked. According to Airclaims, a London-based group that keeps tabs on the world airliner population, the number of jets in storage has increased from around 1,300 on September 10 to 1,986 as of press time. At Evergreen, the population of parked airplanes has increased from a pre-attack total of 130 to almost 170 today, with another 20 expected before things level off. The other desert storage centers—in Mojave and Victorville, California, and in Roswell, New Mexico—have experienced similar upsurges.

I feel fortunate just to be here. None of the other MROs would grant me access, and the officials with whom I spoke were maddeningly skittish. After all, their biggest clients are major airlines, who are understandably anxious about the public's perceptions of their safety and stability, so any discussion of parked or—heaven forbid!—old jets is decidedly taboo. I've been allowed to see this place only on the condition that I not identify any of the airlines whose airplanes I see.

These big jets, far from the bustling ramps at busy airports, seem incongruous here, with their silent engines, foil covers (to keep out birds and dirt), and wrapped tires and windows (to protect against ultraviolet light). Storing an airliner costs

from \$1,000 a month on up, depending on its size and the amount of attention it needs, says Robert McAndrew, Evergreen's vice president for marketing. Keeping a 747 in flyable condition runs \$5,000 a month, with 15 to 20 percent of that going for parking alone.

Airliners are designed to fly, not sit. Aluminum corrodes, rubber dries out, engines rust, and electronics fry in the heat. Keeping an airliner airworthy requires regular inspections, engine runups, taxi checks, and the cycling of all major systems to ensure pneumatics, hydraulics, and avionics remain in working order. All of these routines are mandated by the Federal Aviation Administration. Airlines may opt to simply park a jet and have it brought back to life when necessary, and of course that option costs less. But McAndrew says long-term parking necessitates a lot of extra maintenance at a later time. "It's a question of 'pay me now' or 'pay me later,'" he says.

McAndrew says his firm houses only about 30 jets whose owners aren't interested in returning them to service, and points out that Evergreen recently passed on housing 65 727s retired by a major U.S. carrier that had no plans to fly them.

Overleaf: Airliners on hold. Multiply this crowd by 20 to get a picture of the number of airplanes parked since September 11.



Silver foil protects the engine of a 747.





The storage yards have recently seen the arrival of factory-fresh aircraft whose would-be operators either canceled orders or postponed acceptance.

Since the September 11 attacks, the number of jets in storage has increased by more than 50 percent.

Sometimes, McAndrew says, Evergreen finds itself in the uncomfortable position of nudging owners toward the idea of scrapping their aircraft. He points to a string of 747SPs parked at Evergreen. Right now, the only potential customers for the SP—a short-body, long-wing, long-range variant that has fallen out of favor among airlines—are heads of state, or anyone else with the cash to buy one and convert it into an airborne equivalent of a yacht. “There’s about 30 more SPs out there than there’s a market for,” McAndrew says with a “What are ya gonna do?” shrug. “It comes down to a few thousand dollars a month to store what they think could be a several-million-dollar asset, and right now they’re still willing to take that gamble. It’s when this goes on for six or seven years that you have to start wondering.”

It’s not just old stock that winds up idled. Storage yards have recently seen the arrival of factory-fresh aircraft whose would-be operators either canceled their orders or postponed acceptance until the industry recovers. At the Southern California Logistics Airport in Victorville, I peer through a chain-link fence at 800-series 737s straight from Boeing sitting alongside 600-series 747s recently pulled off the line by United. “They still have the new plane smell,” says airport manager Peter Soderquist.

For all the newer stock at Victorville,

though, I also saw a billion beer-cans-in-waiting in the form of old 727s and L-1011s, 150 of which were idled there even before September 11.

According to Airclaims’ data, 727s in storage have nearly doubled in number, from pre-attack levels of 233 to 415 today. Aging British Aerospace VC10s and DC-9s have also been sent into storage as part of the thinning of the herd that often accompanies downturns in the airline industry.

Back at Evergreen, we leave Alcoa behind as Sharif continues the tour of the 1,600-acre center, weaving expertly under wings and around low-hanging engine nacelles. Outside my window, jets of all sizes and descriptions flash past, everything from towering 747s (Evergreen is home to 60 of the monsters, including the ones used by NASA to piggyback space shuttles around) to MD-80s and 737s that seem diminutive in comparison.

We pass a pair of MD-90s, each of which has around 5,000 hours on it—practically brand new by airliner standards. The jets, owned by a leasing corporation, still sport the colors of ProAir, a now-defunct low-fare regional carrier based in the southeastern United States. “They didn’t make it,” Sharif says. “September 11th killed ‘em.” We continue on, past a major U.S. carrier’s retired DC-10, whose crazed appearance causes me to do a double take.

“What the—?”

“They’re signatures,” Sharif tells me. Writ large along the airplane’s fuselage are hundreds of signatures—some must be as high as two or three feet. The airline’s employees had them scanned into a computer and turned into stencils, which were then transferred onto the airplane. “That was the last DC-10 they flew,” Sharif says. “I guess they wanted to give it a big sendoff.”

We draw up beside a 300-series 747 that came to Evergreen last year. The airplane, which had spent two years on a ramp in Singapore, illustrates what can happen when aluminum meets salt air. When Evergreen’s mechanics inspected the 10-year-old airframe, they found it so riddled with corrosion it made better sense to cannibalize the airplane for parts than to try repairing the damage. “It’s a shame,” Sharif says. “That plane still had a lot of life left in it.”

With the right care, airliners can soldier

Security-conscious storage facilities keep the curious a fairway’s length away. A teen swings his club on a field near Victorville.





A 747, its cockpit and passenger windows sealed against wind, sand, and sun, and a fleet of 737s (below) wait in Mojave's dry air for better times.

on for an amazingly long time. Sharif leads me up inside a 200-series 747 that came to Evergreen for a C check, an inspection it must undergo every two years in which an army of airframe-and-powerplant mechanics spend 5,000 to 6,000 man-hours checking chiefly for corrosion and structural wear and tear. Long retired from its glamour days transporting passengers across the seas, the 25-year-old airframe has been stripped of its seating, carpeting, galleys, and overhead bins, which allows us to see it for what it really is: a vast, pressurized tube.

I follow Sharif up a rickety ladder leading from the main cabin to the flight deck. Technicians test its systems, causing the instruments, running off ground power, to hum. I take in the smell—the same you'd find in any old cockpit: stale sweat, spilled coffee, metal, and oil. I look at the captain's yoke, its black enamel finish worn down to bare aluminum. The instrument panel has a softball-size attitude indicator and rows of old-school "steam gauge" indicators. There is no "glass"—computerized displays that in more modern cockpits take the place of the older

instruments. This 747, so seemingly modern when viewed from the ramp, already belongs to a different era, one in which even the biggest jets came equipped with avionics not much more sophisticated than those found in today's trainers.

This airplane has spent close to 100,000 hours—11 years—in the air. First it delivered hundreds of thousands of passengers, then it became a freighter, carrying countless tons of cargo. The airline that owns it has decided that the potential usefulness of the 747 is worth the cost of another overhaul. But one day, probably not too far off, someone will decide that another inspection is just not worth the expense. With air traffic—both passenger and freight—slacking off as it has, the date with that beer can manufacturer may be just around the corner. —



Resto

Soggy Stratoliner | Boeing 307

David Knowlen chuckles as he recalls one idea for drying a waterlogged airplane: "Somebody suggested stuffing toilet paper rolls into the wings," he says. "When they were soaked, just throw them away."

Knowlen, the director of business affairs for Boeing's commercial airplanes division, received hundreds of similar proposals in the weeks following March 28. On that day, a four-engine Boeing Stratoliner 307 that Knowlen and dozens of volunteers had spent six years restoring crashed into Seattle's Elliott Bay within full view of startled diners at a popular waterfront eatery. The refurbished Stratoliner—the world's first pressurized airliner and one of only 10 built—had been unveiled in

Eight months after preening at the 2001 Oshkosh, Wisconsin airshow (above right), the 307 ended up in the drink (below). To get it to shore, salvagers lowered the craft onto a padded barge (below right).

June 2001 and was destined for the National Air and Space Museum's new Steven F. Udvar-Hazy Center in northern Virginia. But on an afternoon test flight, pilots Richard Nelson and Mike Carriker broke off an approach because a landing gear malfunctioned. The engineer manually extended the gear, but the airliner then lost power in all four engines, forcing Nelson to ditch.

After hearing the news, Knowlen, program manager for the restoration, started dialing the 70-plus volunteers who had taken a battered, neglected aircraft and painstakingly transformed it into a gleaming incarnation of the Stratoliner's original luxe appearance. "To a person, they all said they'd go back to work," Knowlen says. Thirty hours after the ditching, the Stratoliner was back in the hangar. Crews stripped off the engines, fuel tanks, and interior fittings and began flushing out Elliott Bay's corrosive saltwater with fresh water from high-pressure hoses. (Another suggestion e-mailed to Knowlen: "Just dip it in a fresh-water lake.")



Six weeks after the mishap, the Stratoliner was perched on jacks, water still dripping from open panels, its hand-polished aluminum skin splotchy from its dip in saltwater. But Knowlen saw reason for optimism. "This looks miserable," he says, running a hand along a jagged gash in the starboard wing, one of many gouges and dents. "But the aircraft is structurally sound." For that, credit the Stratoliner's rugged construction. The aircraft, which first flew in 1938, shared many design features with the B-17, one of the most battle-worthy aircraft ever built.

Not that there isn't plenty of work ahead. Electrical components, engines, and the Stratoliner's Pullman-car-like leather-and-wood interior appointments all were damaged. The engines, instruments, and wiring are being rebuilt or replaced;



CHERYL HATCH / AP/WIDE WORLD PHOTOS

JIM BATES / THE SEATTLE TIMES



Boeing mechanics Rex Hatfield and Mike Sorenson remove soaked floor boards.

RANDY O'BREZAR



RANDY O'BREZAR

ration

such rare items as the wall fabric, woven with the Pan American logo by F. Schumacher & Co. of New York, was stained by hydraulic fluid and saltwater and will have to be re-created. Crews are constructing new skin panels to replace many of those damaged.

Weeks after the crash, investigators continued to look for the cause of the Stratoliner's near-catastrophic mishap. The culprit clearly was lack of fuel, and National Transportation Safety Board investigators were looking at little else, according to Debra Eckrote, an investigator in the Seattle office of the agency. But why did experienced pilots allow the tanks to go dry? One plausible scenario: The gauges or fuel tank sensors were simply wrong. In fact, checking their accuracy had been among the goals of the test flights, as engineers compared fuel loads before and after the flights with instrument readings of consumption and fuel levels. As this issue went to press, the NTSB had tested the fuel system and was finishing its report, which will incorporate information provided by the pilots.

Knowlen is determinedly cheery about the re-restoration. "Out of a situation that was unfortunate," he says,

"some good things have come. So many people who had not been involved [in the original project] have offered help." But for some of those who spent years restoring the Stratoliner, the sight of its dulled and torn skin was, at best, disheartening. "If you stand back and look at it now, it's a little discouraging," says Elliott Brogren, who retired from Boeing after 35 years as an engineer. Brogren had spent more than two years rebuilding the Stratoliner's battered luggage compartment. But at least this time he has all the pieces he needs. "Before, we were scrounging all over for parts," Brogren says as he carefully repairs a window shade on the hatch used by Nelson, Carriker, and their two passengers to escape the downed craft. "Now, when we take something off, we save it for repair or use it as a template [for creating a duplicate]." Since the Stratoliner is the only one remaining

of its kind, there are no sources for spare parts.

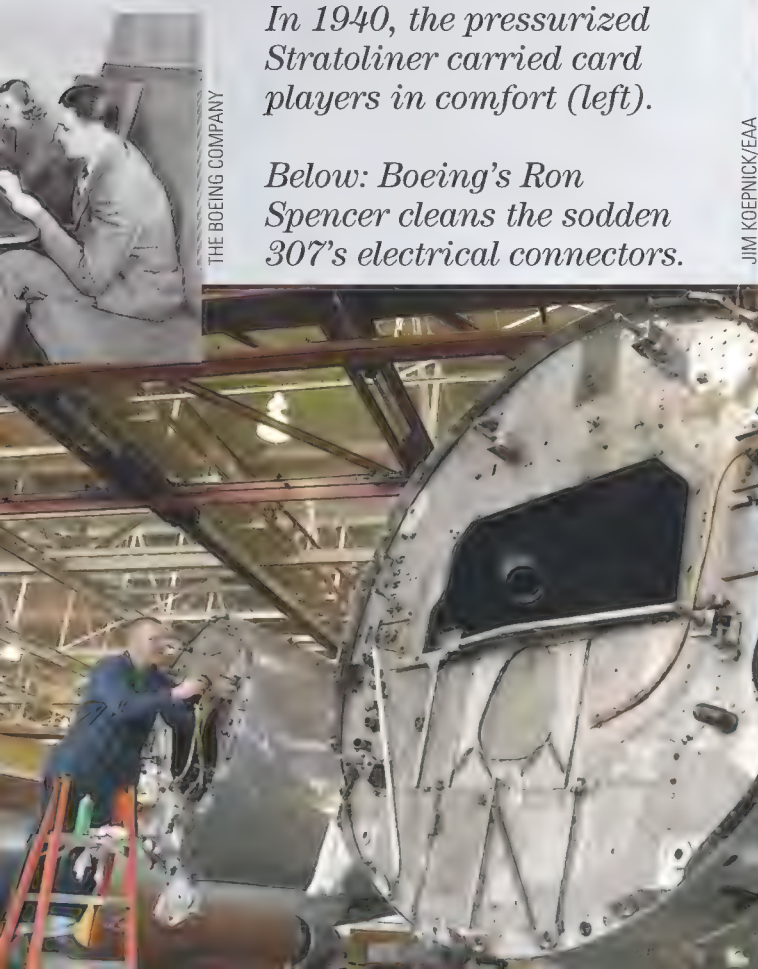
An accident of timing is the reason only 10 Stratoliners were built, according to F. Robert van der Linden, the airplane's curator at the National Air and Space Museum. "It was a great airplane," he says, "but World War II got in the way." By the end of the war, the bigger, faster Lockheed Constellation had supplanted the Stratoliner.

At the new museum, the Stratoliner will join a Constellation, the Boeing Dash 80 (the 707's prototype, now under restoration right next to the Stratoliner), and a Concorde, among other airliners. In late June, Boeing decided to again restore the aircraft to flying condition, so it can fly to its new home, instead of having to be trucked. No one wanted the Stratoliner's last flight to be the one that ended in Elliott Bay.

—Douglas Gantenbein

In 1940, the pressurized Stratoliner carried card players in comfort (left).

Below: Boeing's Ron Spencer cleans the sodden 307's electrical connectors.



Restored and polished, the Stratoliner stole the show when it flew at Oshkosh last summer. Its next scheduled flight: coast to coast, for delivery to the Steven F. Udvar-Hazy Center next July.

TICKET *to* ORBIT

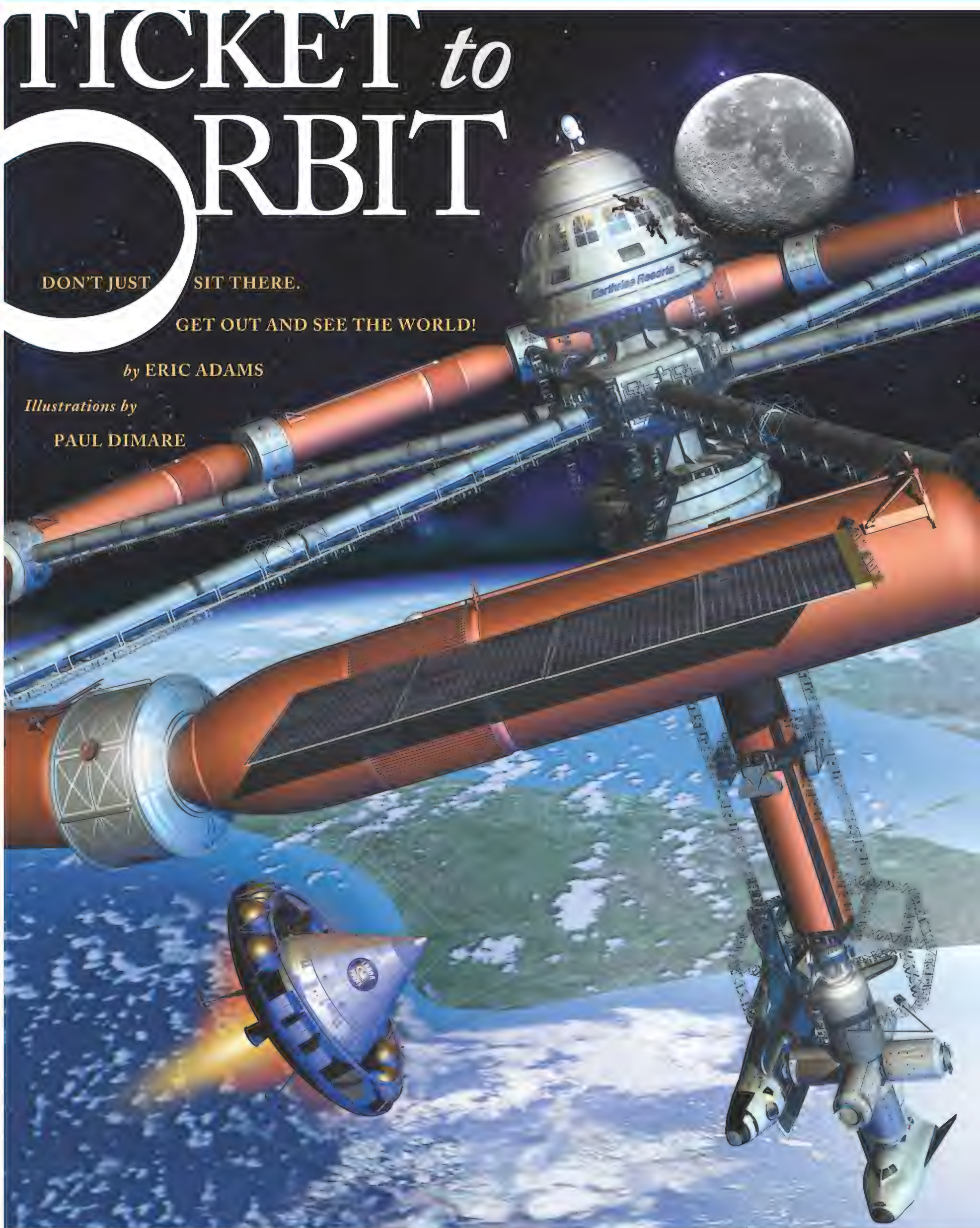
DON'T JUST SIT THERE.

GET OUT AND SEE THE WORLD!

by ERIC ADAMS

Illustrations by

PAUL DIMARE





Future recreational space travel might rely on adaptations of existing vehicles, such as these cleverly re-used space shuttle external tanks, but entirely new vehicles will also be a necessity.



n the moon, we'll wear jet packs, drive fully enclosed lunar buggies, and explore vast craters. In orbit, we'll dance in zero-G ballrooms and gaze placidly at Earth while sipping martinis from foil baggies.

This is the future we've been promised by scientists, entrepreneurs, and other space visionaries for the last 50 years, beginning with the futuristic Chesley Bonestell illustrations published in *Collier's* magazine in the early 1950s—with accompanying articles written by no less an authority than Wernher von Braun. Although the government's space program has focused on such serious matters as national prestige from the Apollo era up through the dawn of the space shuttle years and, now, the birth the International Space Station, there have been, along the way, scores of proposals and studies speculating on the future of recreational space travel. In 1998 NASA and the Space Transportation Association completed a study that predicted that suborbital flights and visits to private space

You'll get lounges, athletic facilities, and a room with a view. Just don't open the windows.

stations would be highly profitable and are worthy of "serious national attention." More recently, Kelly Space & Technology, a launch technology firm that is turning its attention toward passenger-carrying vehicles, conducted a market survey that forecast the demand for seats into space. Both studies suggest that tens of thousands of private citizens will spend enormous amounts of money to travel into space—from tens of thousands for suborbital flights to millions for orbital stays.

The recent flights of U.S. businessman Dennis Tito and South African Internet entrepreneur Mark Shuttleworth, who both paid for rides into orbit aboard Russian launchers, week-long stays aboard the ISS, and hair-raising free-fall descents in Soviet-era capsules, seem to validate this research. Their tickets: \$12 million to \$14 million each—not the \$20 million generally

reported, according to Space Frontier Foundation president Rick Tumlinson, a space commercialization advocate who advised Tito during his negotiations and is familiar with Shuttleworth's. Indeed, to many in this nascent field, these two flights signal, if not the true birth of space tourism, at least its first data points. "They have been absolutely critical in moving the concept of space tourism from something that many dismiss as fantasy to something that has made millions of dollars," says John Carmack, founder of Armadillo Aerospace, which is developing a hydrogen-peroxide-powered suborbital vehicle. "An 'existence proof' beats all the plans and studies in the world," he adds. Two other potential space tourists, Lance Bass of the band NSYNC and former NASA associate administrator Lori Garver, are vying for the next seats. Radio Shack has signed on to sponsor Bass' flight, while Garver is still looking for sponsorship.

In addition to Carmack's firm, numerous other companies—including Canadian Arrow and Bigelow Aerospace—are developing passenger-carrying vehicles for suborbital flights, which will provide roughly hour-long excursions with about two to five minutes of weightlessness. The \$10 million X-Prize, created by space commercialization advocate Peter Diamandis, will be given to the first team to execute two such flights in a two-week period. Many of the competing companies see it as a prime incentive for launching their efforts to build a passenger-carrying space vehicle. "Winning the X-Prize is our major goal," says Geoff Sheerin, whose company, Canadian Arrow, is building a rocket based on the relatively simple V-2 that the Germans developed during World War II. Sheerin adds that a potential payout of \$10 million has allowed him to draw in corporate sponsorship and private investment. "Whether we win or lose, we expect to enter what we believe will be a very lucrative industry," he says.

With individuals seeking expensive stays on the ISS and startups pursuing vehicles for the masses, there certainly seems to be momentum toward a viable space tourism industry. But going from a handful of multi-million-dollar flights aboard government-owned vehicles to a self-sustaining industry remains a significant leap. Some hard-charging entrepreneurs, foremost among them Eric Anderson, president of Fairfax, Virginia-based Space Adventures, which coordinates space-

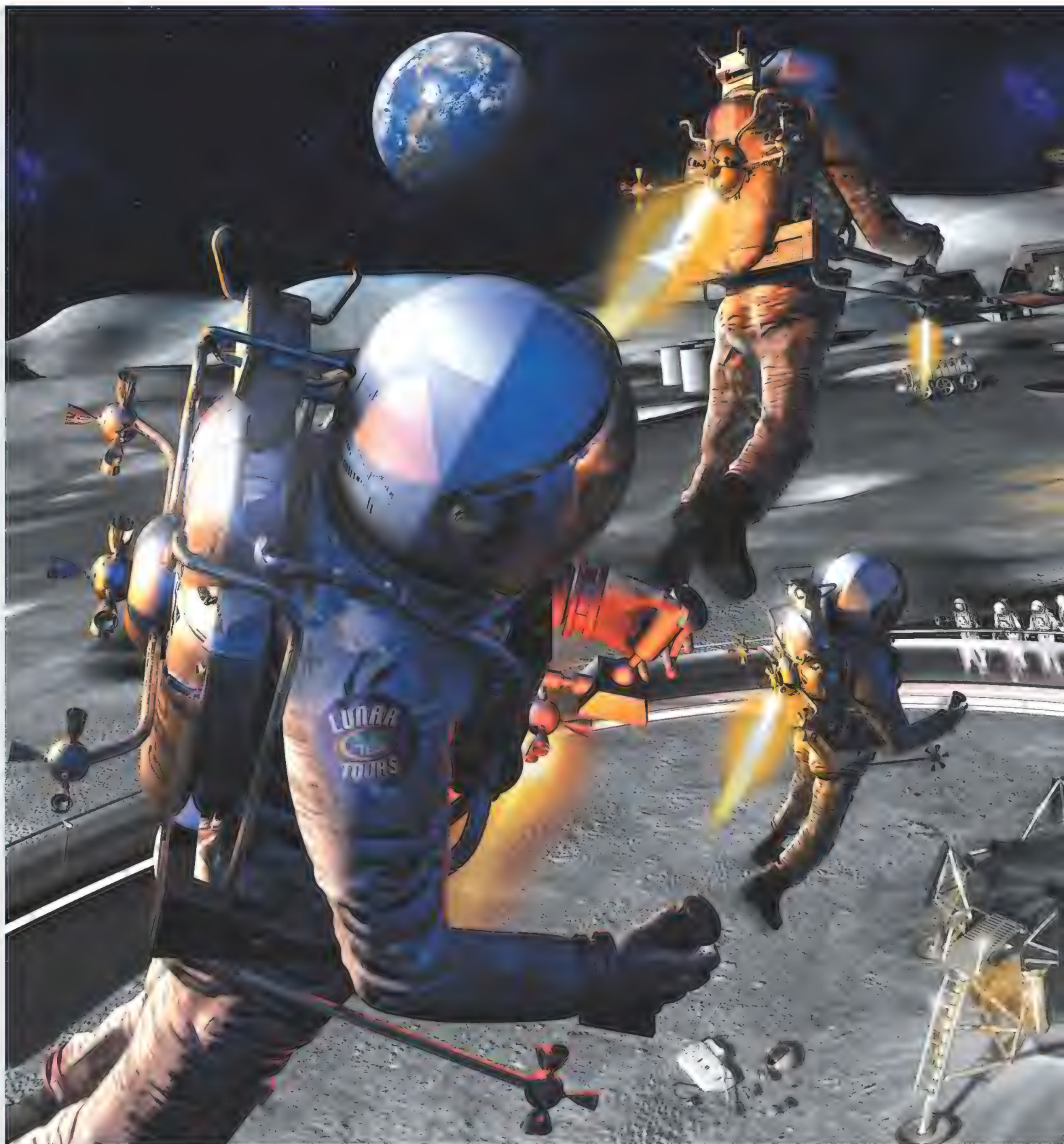
themed excursions (supersonic, high-altitude flights aboard Russian fighter jets, parabolic weightlessness-simulating flights in cargo aircraft) and helped arrange Shuttleworth's flight, insist that orbital flights will be an affordable opportunity in only five to 10 years, and private mini space stations in 15. "There is a huge amount of public interest in space exploration," says Anderson, citing his firm's extensive market studies. "Dozens of people would pay up to \$20 million for an orbital flight, and tens of thousands would pay \$100,000 for a suborbital flight. As these businesses develop, we'll reinvest that money into improving the technology. It's a self-fulfilling prophecy."

Others wonder whether such factors as cost, risk, and sheer technical difficulty will push all of these dates back by decades. "I consider myself a realist," says John Logsdon, director of the George Washington University Space Policy Institute in Washington, D.C., which has been studying the commercial potential for space for nearly 30 years. "I suspect that all this will happen at some point in the future, but I think the future is much farther away than some people want it to be."

Of course, significant hurdles face the people trying to develop space tourism, and chief among them is financing. If you thought pop-up ads on the Internet were annoying, wait until you get to orbit. Corporate sponsorship, all agree, will be key to the success of commercial space travel. Lance Bass backer Radio Shack is also sponsoring an effort to launch a robotic rover to the moon. The rover, being developed by LunaCorp, will relay its explorations back home to audiences sitting in full-surround theaters mounted on motion-registering platforms. The company has been developing robotic technology with Carnegie Mellon University in Pittsburgh, and is currently field-testing its rovers prior to a launch it hopes to pull off within the next two years.

Most space tourism prognosticators realize the financial benefits of corporate advertising and orbiting media "events." But they too will be reluctant to participate in a substantive way until safety and reliability are proven. After all, Tumlinson says, "if you blow up Lance Bass, you're going to have 200,000 teenage girls who are never going to buy your product."

Investors in space tourism efforts simply haven't stepped up to the plate. Bob Halterman, former director of the space

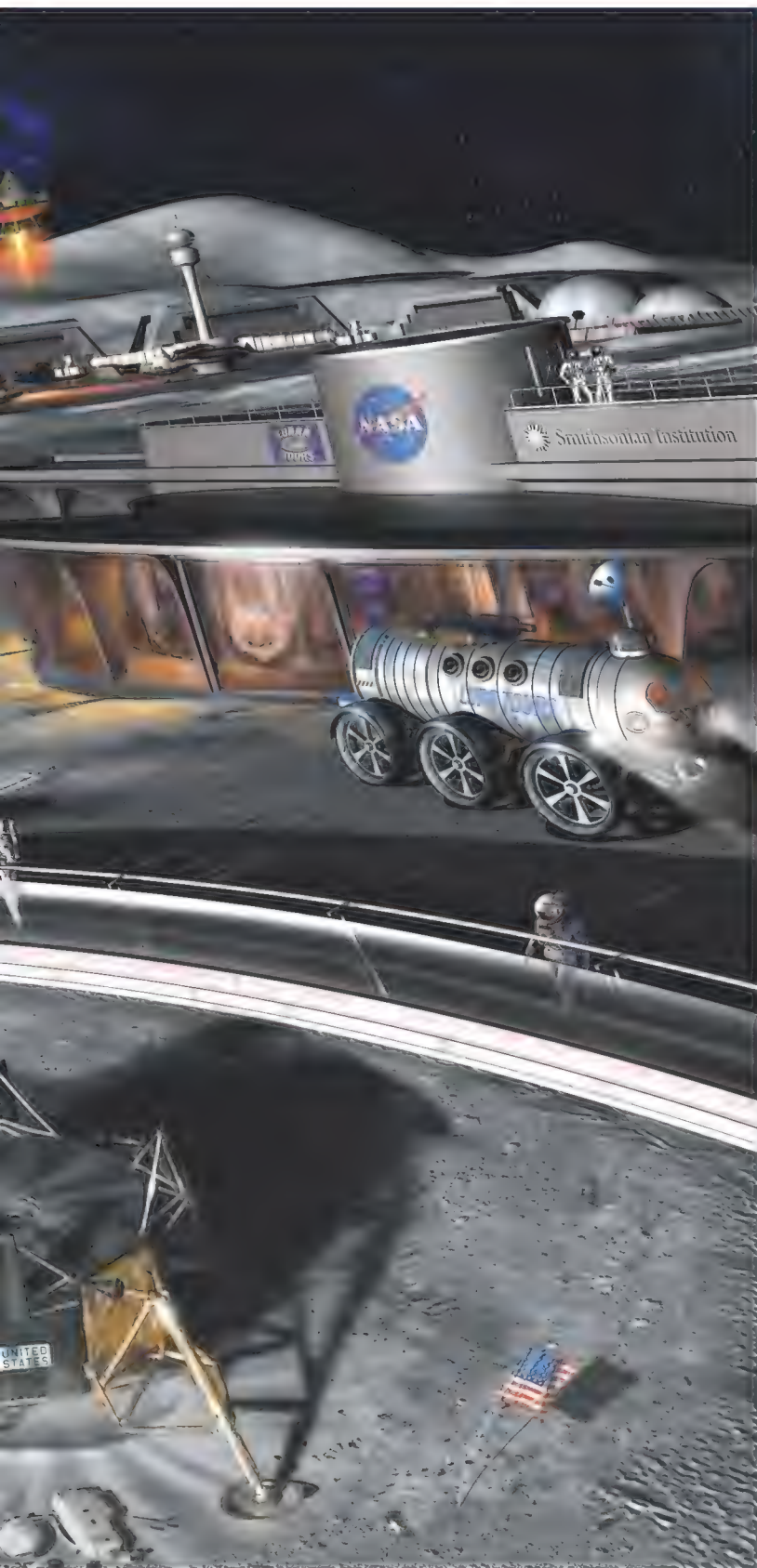


travel and tourism division of the SA and now a consultant, says investors are going to have to shift their expectations. "There's a lot of interest out there, but the challenge is getting investors to accept that this is a longer-term investment," he says. "They usually expect a return on their investment by the end of the third year. That's just not possible in any space endeavor. They have to be willing to wait five to 10 years."

Logsdon argues that suborbital flights aren't necessarily going to give people enough thrills for the money they're paying, and they aren't going to advance the industry substantially. "Space tourism is going to emerge from government development for government purposes, and then the adaptation of those new vehicles

for private uses," he says. "Getting people to orbit is very hard—there's a big difference between suborbital and orbital flights in terms of materials and technology."

Canadian Arrow's Sheerin counters that the technology now being developed for suborbital flights isn't being fully appreciated for its potential. Even though the weightlessness will be limited, he says, the thrill of the launch, the views, and the reentry and descent will be plenty thrilling. But more importantly, he argues, suborbital flights have enormous potential as a practical means of travel. "People are missing the obvious as far as suborbital flight is concerned," he says. "It makes more sense for anyone wishing to travel from continent to continent, with 40-minute flight



When will you get to explore Apollo sites on the moon? It depends on whom you ask. It might be 30 years, or it might be 300.

times to anywhere in the world. The only reason to go orbital is to stay in space or travel to other worlds. So for perhaps a few decades, the money earned by the high passenger count on intercontinental spaceflights will eclipse that earned by hotels in orbit."

One factor apparently destined to benefit the private development of vehicles is the fact that the current satellite market is faltering. Space tourism may still be a market without an industry, but space technology is currently an industry without a market. "There were only 16 commercial

launches last year," says Diamandis (there were 30 in 2000). "The satellite market has dried up, thanks to fiber optics, better cell phone coverage, and longer-duration satellites. Many launch technology companies are turning toward tourism to market their services." Kelly Space & Technology is one example. The San Bernadino, California-based company used to focus on satellite launches, but now it is concentrating on the development of the Eclipse Astroliner, a rocket-powered delta-wing aircraft intended for suborbital flights.

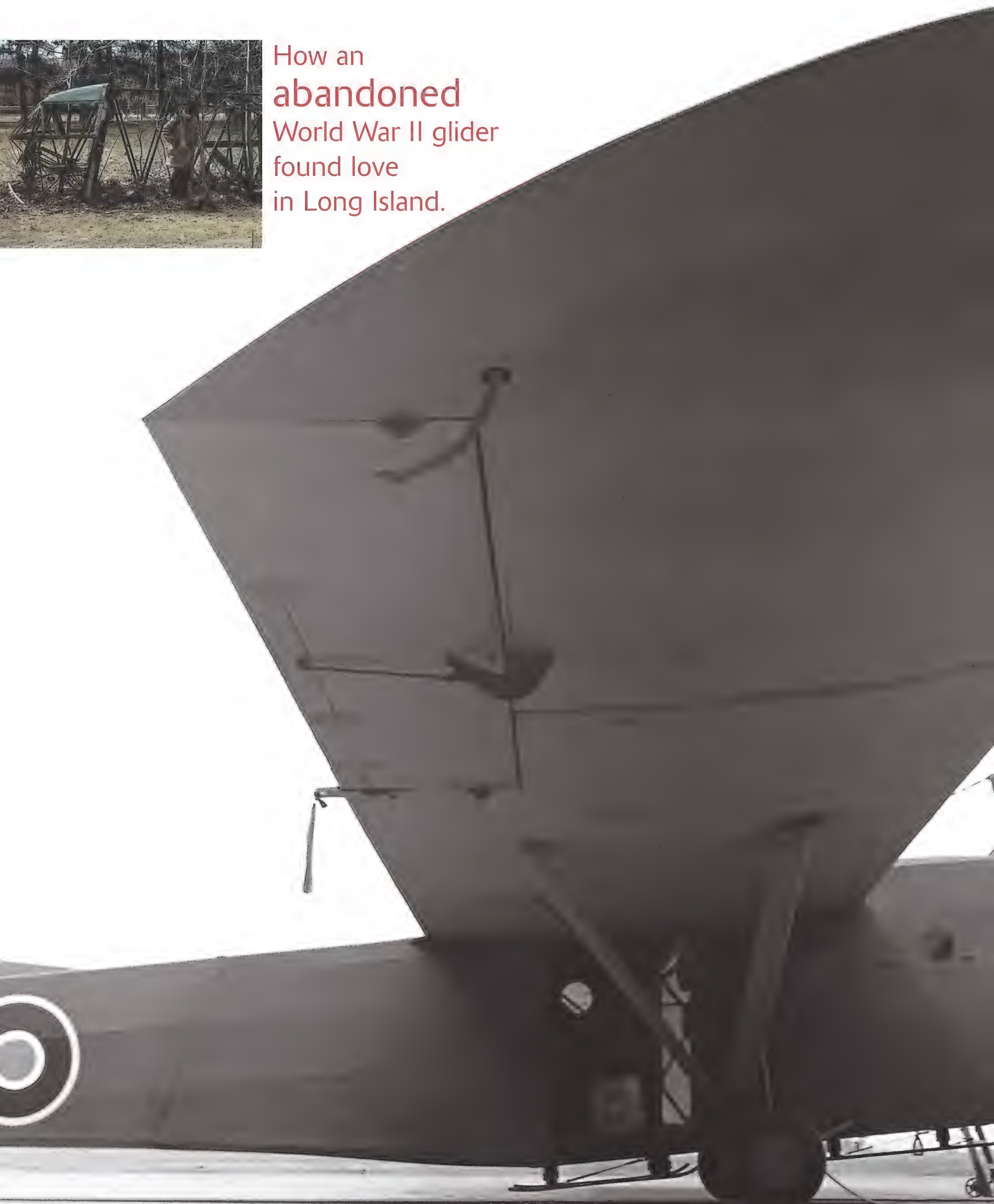
Once a company has found financing and a safe, reliable launch vehicle, it will still face the hurdle of government regulation. Diamandis points out that the industry is so new that the regulatory structure to allow for suborbital and orbital space tourism doesn't yet exist, so regulatory issues will be argued as they become relevant. To help, he is proposing a plan, the "accredited passenger program," which he hopes will eliminate the need for extensive, general-aviation-style certification of suborbital launch vehicles and generally circumvent the Federal Aviation Administration and the Department of Transportation's intrinsically risk-averse nature. The plan is similar to the Securities and Exchange Commission's accredited investor program, in which investors who have demonstrated their expertise—as well as their wealth—are allowed to invest in companies that are not publicly traded. "It will allow passengers to go through training and testing, and it will be up to them to take the risk," he says.

Will it be worth it? Mark Shuttleworth, speaking from Moscow after his flight in April, summed up his experiences nicely: "Anything that fundamentally challenges you is a good thing in the long run," he said. "With trips like this, you'll learn things you've always wanted to learn, and experience the magic of space. But from a sheer testosterone point of view, reentry was unbelievable—the ride of a lifetime."

When everyone else will get such rides is anybody's guess. For some reason, the predicted timeline has always been the same. In 1950, space travel promoters predicted that it would only be about 30 years before hotels were built in space. In 1970, it was also roughly 30 years. And now, 30 years later—when you average out the optimistic and the conservative estimates—it's still 30 years away, long enough for everyone in the field to hedge their bets, yet close enough to seem to be "in our lifetime." —



How an
abandoned
World War II glider
found love
in Long Island.





A WACO'S Happy Ending

by Joshua Stoff

**WANTED: Waco CG-4
Troop Glider – any
airframe components,
any condition...**

Thus began a small advertisement I placed in a January 1987 issue of the tabloid *Trade-A-Plane*. I had no idea that the advertisement would send me on a journey that would last 15 years.

I was (and still am) the curator of the Cradle of Aviation Museum in Garden City, New York, founded in 1979 to “collect, preserve and interpret the aerospace heritage of Long Island.”

That mandate is a bigger job than it might sound

like: More than 50 manufacturers have produced air- and spacecraft here continually since 1909. Over the years, we have been able to acquire over 60 craft, nearly all of them local products. But sadly, most of the wide variety of aircraft produced here either no longer exist or are now so rare that we can't afford to acquire an example.

One of those rare aircraft is the Waco CG-4 troop glider. Early in World War II, the Germans had had success using gliders to land troops in combat zones, so the U.S. Army decided to develop a similar corps for itself. Glider transport had two advantages over parachuting: The soldiers ended up concentrated near a target, rather than spread over the countryside, and the gliders could also be used to transport cargo.

In response to the Army's decision, the Waco Aircraft Company of Troy, Ohio, probably best known for its open-cockpit biplanes, designed the CG-4 in late 1941. Weighing 2,400 pounds and having an 83-foot wingspan, the glider was ungainly but robust. In addition to two pilots, each CG-4 could transport 13 troops and all of their gear, or a jeep or light artillery.

No beauty, the CG-4 was an efficient hauler. The one at left, nose open for loading, served the British. Opposite: The author encounters a rare survivor.

OPPOSITE INSET: THE CRADLE OF AVIATION MUSEUM; OPPOSITE: NASM NEG. #2002-3804

Though the war planners found the gliders efficient, the men who actually participated in glider missions found the experience arduous. A Douglas C-47 transport towed the glider on a 350-foot nylon rope; a typical tow would last several hours and be flown at about 100 mph and 1,500 feet. Low-altitude turbulence wore out the C-47 pilots and made the troops in the glider airsick. The landing zone had no air traffic control; once over the zone, the glider pilot would release his craft at about 400 feet, in order to minimize the time that the unarmored glider would be vulnerable to enemy gunners on the ground. In addition, when a large number of gliders were released over a relatively small landing zone, they would sometimes crash into one another, or into trees or other objects.

Nonetheless, the gliders achieved some remarkable successes. During the D-Day invasion, 513 gliders were landed in Normandy, France, and only 11 percent of the troops inside were killed or injured during the landings.

The pilots of these remarkable craft were often students who had washed out of fighter or bomber training. They were, however, trained well enough to make at least one successful landing. Similarly, the gliders themselves were considered throwaway aircraft, used once and rarely retrieved. Of the nearly 15,000 built, only five or six survive.

This aircraft had always intrigued me, and I felt I had to have one for our collection. Of the 16 companies that had produced CG-4s, two had been located here on Long Island—General Aircraft in Queens and Dade Brothers in Mineola, together producing about 1,000. In fact, our museum's founder was Dade Brothers' George Dade, and he continually prodded me to locate a glider carcass to restore. After a couple of years of fruitless phone calls and letter writing, I placed my ad in *Trade-A-Plane*.

I failed to receive a single letter in response. Considering how few had

survived the war, I was not surprised. However, about a month later, someone who had seen the ad called me. An airline pilot, whose name I'm sad to say I've forgotten, told me that as he was driving outside the small village of Nazareth, Pennsylvania, near the Pocono Mountains, he thought he saw the bones of a troop glider lying in a farmer's field. I was astonished—not just that he had made the effort to call me, but that he had actually identified the remains as a CG-4.

Before the week was out, George Dade and I were headed west toward Pennsylvania, not knowing exactly what side of town the farm was on or even who owned it.

After a drive of just over three hours, gradually transitioning from the suburbs of New York City to the fertile farmland of eastern Pennsylvania, we passed a sign stating "Nazareth 1 mile."



THE CRADLE OF AVIATION MUSEUM



NASM NEG. #2002-3806



Above left: Workers assemble glider wings at the Dade Brothers plant in Mineola, Long Island, in 1944. Left: The hearty CG-4 could transport not just soldiers but jeeps. Above: The lack of combat gear and the presence of parachutes indicate that this photograph was taken on a training exercise, rather than a combat mission.



NASM NEG. #89-4502

We began to keep our eyes peeled.

Suddenly my jaw dropped and I slammed on the brake. About 100 feet to the right lay the complete nose and main fuselage section of a Waco CG-4 troop transport glider.

We pulled over, got out, and walked to the nearby farmhouse. A knock on the door brought forth an ancient farmer, who was amazed to learn that someone had traveled all the way from New York just to look at his pile of rusted scrap. It turned out that the farmer (who no longer farmed) had purchased the glider as war surplus in 1946 for \$75 from an Army depot in Pennsyl-

vania. He had no interest in the aircraft, only in the three large and sturdy crates it came in, which he turned into chicken coops. As for the glider, he dumped it in the field, where it rusted away for the next 40 years. Gradually it became covered in weeds, and as its fabric skin deteriorated, small trees sprouted and grew through its steel-tube frame.

A sale price of \$150 was quickly agreed upon. I suspect the farmer thought he had really hoodwinked a couple of slick New Yorkers—not only were we willing to take away his pile of junk, we would even pay him good money to do it.

Walking around the bones of the glider that day, I realized the restoration would be a major project, requiring many years. The parts were badly rusted. Where some of the fittings had touched the ground, corrosion had completely eaten them away. On occasion, when the farmer had needed a piece of metal tubing, he'd simply walked over and sawed a section out of the glider's skeleton. The tail and wings were gone, as were other critical components. Amazingly, the nameplate of the manufacturer, Ford, was still firmly affixed to the fuselage's rusted doorframe.

Fortunately, it turned out that the farmer had for some reason stored some of the more interesting glider parts in his barn loft. We climbed up a rickety ladder and quickly discovered wooden troop benches, pilots' seats,

back rests, instruments, wheels, tires, landing gear struts, and several other items.

I quickly made plans to return within the week. Our museum has a corps of volunteers, most of whom are retirees from local aerospace companies or the airlines, and many of whom served in World War II, and I recruited six to help retrieve the glider. I also borrowed a flatbed truck and rounded up an assortment of hand tools. During the next few days, I actually worried that some other museum might come along and scoop the glider up.

To my relief, when we arrived, it looked just as it had when we'd left it. We ended up putting in a long day's work, cutting down the ingrown trees and slowly easing the rusted hulk in one piece onto the truck. Our volunteers were tickled by my repeated warnings not to scratch anything (I was only half jesting).

Upon unloading the glider at the museum, I attacked the project from two angles. I assembled a crew of about 15 volunteers, who, although questioning my sanity at first, cheerfully agreed to spend several years of their lives working on the project. We also contacted the National Air and Space Museum and obtained copies of the CG-4 "Erection and Maintenance Manual," as well as printouts of the microfilmed blueprints. With these in hand, I was able to compile a list of the parts we needed—a very long list.

Early on, we decided to restore the



CG-4s were considered expendable; after landing, few were brought back. This photograph shows a rare retrieval. In these lifts, a C-47 would fly by and use a hook to grab the glider's tow rope.

NASM NEG. #2002-3504



Ravaged by 40 years of exposure to the elements, the old farmer's CG-4 still had the sleigh-shaped nose that revealed its identity (above). Right: At the museum, the fuselage's frame was straightened and missing sections replaced.



THE CRADLE OF AVIATION MUSEUM (2)

glider with only one of its enormous wings. For one thing, that would save a lot of time and money. In addition, we wanted to exhibit the glider as a cutaway, so not having a wing on the cutaway side would enable visitors to view the interior. The decision exemplified a philosophy we had developed at the museum. Rather than just lining up aircraft and putting labels in front of them, as many aviation museums do, we tried to bring them to life. For example, we

exhibit our early aircraft in a re-creation of a 1911 air meet, our World War II naval aircraft on an carrier flight deck scene, and our Apollo Lunar Module on a faux lunar surface. I thought that visitors could understand the CG-4 and its mission best if they were able to see it suspended as if in flight and packed with troops, as it would have looked on D-Day. The cutaway side would reveal not only the glider's internal structure but also a full load of troops and their gear.

Over the next three or four years I conducted a tedious search for CG-4

components, contacting museums, organizations, and collectors from coast to coast. More parts turned up than I expected. A warehouse in Iron Mountain, Michigan, turned out to have a complete and even rust-free tail section. The owner agreed to donate it, and shortly afterward it arrived in New York strapped to the top of a minivan. Complete and original wing spars were found in an old glider factory in Hudsonville, Michigan, and we purchased them for \$225. The Silent Wings Glider Museum, then in Terrell, Texas (it since moved to Lubbock), proved ex-





Above: Volunteers prepare to move the fuselage from Pennsylvania. Right: The fuselage's restoration is almost complete. Though this example never went abroad, the museum gave it the stripes painted on all aircraft that flew on D-Day.



THE CRADLE OF AVIATION MUSEUM (2)

tremely helpful. It has its own CG-4 and, happy to see another restored, generously allowed our volunteers to pick through its storage area, where they turned up a treasure trove of wing ribs, tail parts, and many critical metal fittings. Soon the parts were headed for New York in a rented truck. And the Kalamazoo Aviation Museum in Michigan, also in the throes of a CG-4 restoration, agreed to swap its duplicate parts for ours. The trade provided us enough original parts to build all the missing tail surfaces.

Over the years, we made steady

progress. A new wooden floor had to be fabricated—quite a substantial undertaking. The fuselage was straightened, sandblasted, repaired, and repainted. Then the steel-tube structure was covered with cotton fabric, which we brushed with dope, a fabric-tightening compound. The tail surfaces were covered with thin plywood and fabric. We had learned that our glider, built late in the war, had never been sent overseas (hence its survival), but for education purposes, we decided to paint it with D-Day markings.

By far the largest and most tedious

part of the restoration was the wing. We were fortunate to have obtained original spars, some ribs, and all the metal fittings we would need. Nonetheless, re-creating that wing just went on and on. The wooden truss-like ribs were complicated, and we had to make a lot of them. When the frame was finally complete, we had to cover it completely with dozens of thin plywood sheets. And then the wing had to be covered entirely with cotton fabric—seemingly acres of it—which then, like the fabric on the fuselage and tail, had to be doped and painted.



NASM NEG. #2002-3808

Enormous wings enabled CG-4s to glide 13 troops plus two crew members to their destination.



After that, it was time for the finishing touches. A local artist applied nose art, copied from a photograph we had of a CG-4 that flew on D-Day. For our 15 mannequins, we had to spend over \$10,000—as much as we'd spent on the acquisition and restoration of the aircraft itself! We also were able to locate original and reproduction World War II gear and weapons so we could make the mannequins look as realistic as possible.

At long last, some seven years later, our glider was complete. We sent valuable leftover parts back to the Silent Wings Glider Museum and also to the Yankee Air Force Museum in Belleville, Michigan, which had embarked on a CG-4 restoration of its own.

Because we were constructing a new museum building, we could not display

our CG-4 immediately. We wrapped it up and put it in temporary storage. Now we had only one critical problem left to solve: How do we suspend the large and heavy glider, especially since its structural integrity was questionable?

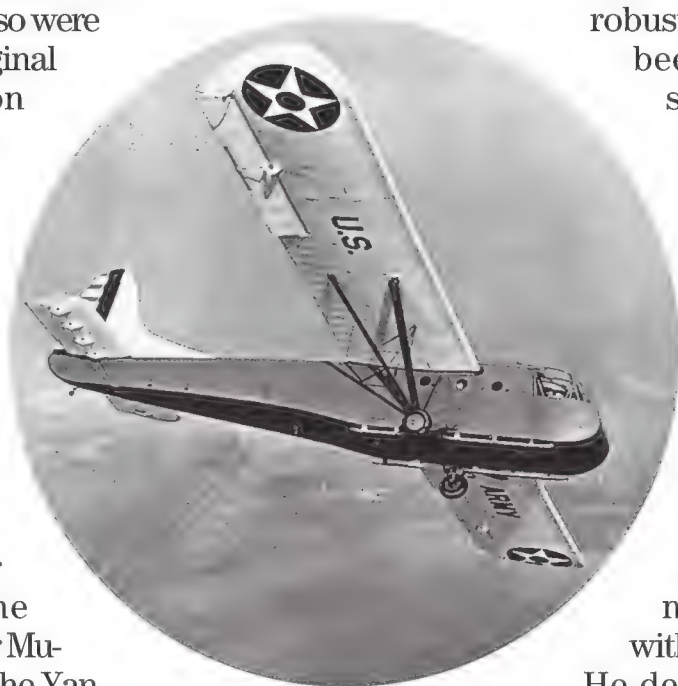
When new, the CG-4s were robust, but this one had been extensively restored, and most of the steel components were at one time severely corroded. Attaching cables directly to the glider could pull it apart. We hired a structural engineer, one recently retired from Grumman and familiar with aircraft materials.

He devised an internal steel skeleton; the glider was bolted around it and suspension cables were attached to its top. The skeleton is able to carry the entire load safely and as unobtrusively as possible.

Last April, prior to the opening of the expanded and renovated Cradle of Aviation Museum, the Waco CG-4 glider was gently raised up and hung in position. We were surprised to see that it had turned out to be quite a majestic-looking aircraft. It was a tribute not only to those who built and flew these craft but also to those who lovingly restored this particular example decades later.

Today it hangs next to an elevated walkway from which visitors can study its cutaway side. The copilot can be seen reaching up for the tow release handle. One airsick soldier is being berated by his buddy, while an old lieutenant shouts last-minute instructions to his young platoon. The Waco glider will be forever flying, filled with soldiers caught in a moment of nervous excitement just before landing on D-Day. ✈

Images of the glider in flight (left, a CG-4 prototype) don't capture the human drama of a CG-4 mission, as the museum's finished display does (above).



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How Things Work:

Ring Laser

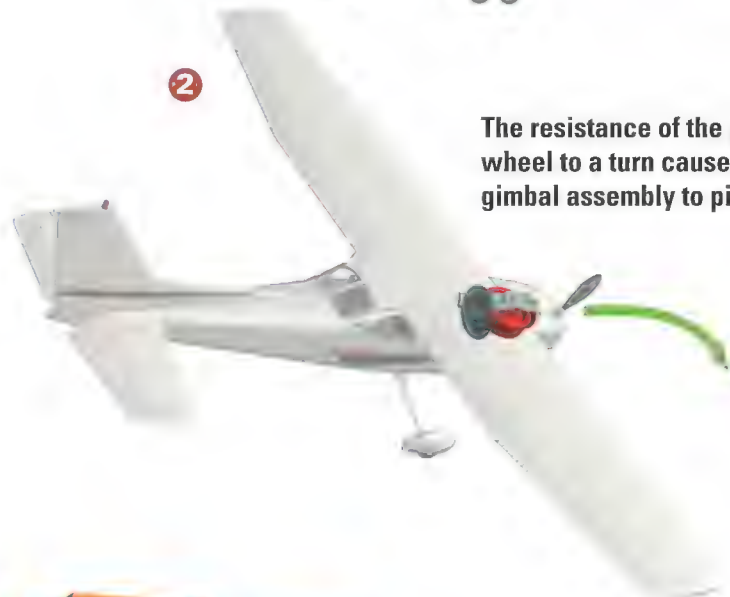
by Linda Shiner | Illustrations by John MacNeill

Charles Draper, whose eponymous laboratory developed the guidance systems for Apollo spacecraft, referred to inertial navigation as “astronomy in a closet.” It is based on a celestial reference system but is at the same time a self-contained process.

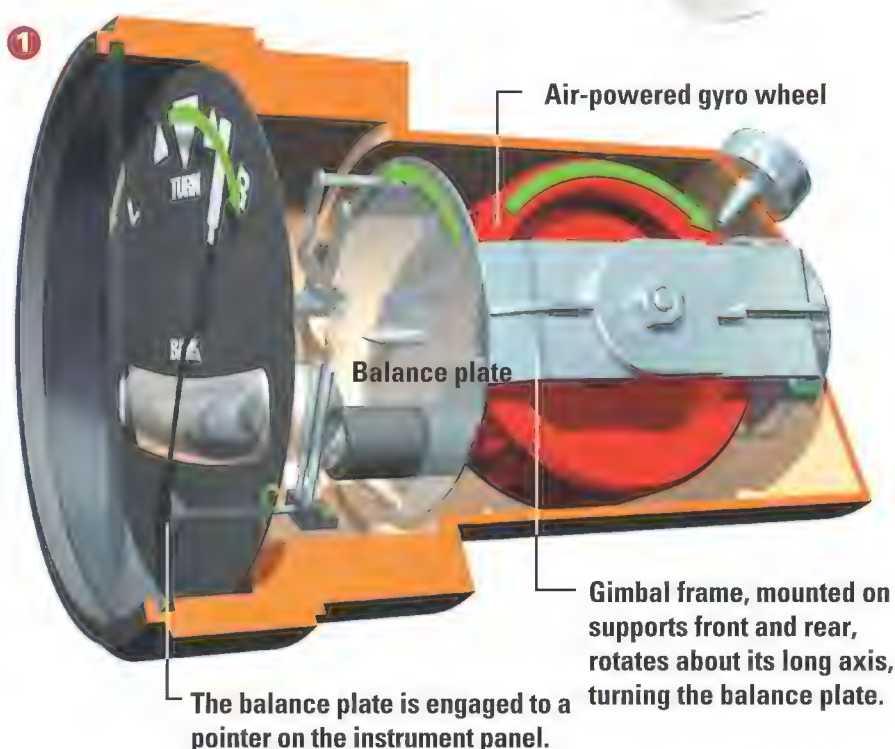


2

The resistance of the gyro wheel to a turn causes its gimbal assembly to pivot.



1



Inertial guidance systems determine location and orientation not from sightings of the stars or landmarks, nor from signals from the ground, but solely from instruments carried aboard a moving craft.

The Apollo astronauts were able to navigate to the moon because they had four sets of information. First, they knew where they were when they started. Inertial systems measure change from a single starting point and within a frame of reference (which indicates true vertical and two axes at right angles to the vertical and each other). Instrument measurements provide the three remaining sets of information: changes in acceleration, time, and rotation. Accelerometers enable pilots (or their computers) to calculate speed and, by integrating speed and time, distance. Changes in rotation, including heading, are the province of gyroscopes, mechanical devices consisting of a spinning wheel mounted in one or more gimbals.

One of the simplest of such devices, the turn indicator on a light aircraft, operates on the same principle as do the massive, complex gyroscopes that help maintain the orientation of the International Space Station. That principle is gyroscopic inertia, the tendency of rotating objects to maintain a fixed orientation, resisting forces trying to tilt them. Gun makers take advantage of gyroscopic inertia by cutting grooves in the interior of a gun barrel to impart spin to the exiting bullet and so keep its path straight.

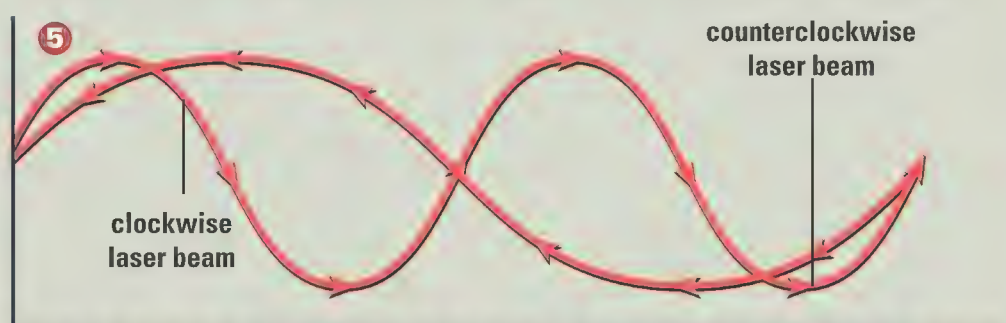
The gyro wheel on an airplane’s turn indicator, driven by a stream of air to spin as fast as 10,000 revolutions per minute, imparts a stabilized reference line, or axis, against which rotations can be measured ①. When a rotational force, or torque, is applied to the gyro assembly, the assembly reacts in a predictable way: It resists the torque and rotates instead about its gimbal axis. The predictability of this action enabled engineers to design the device that measures an airplane’s rate of turn. When an airplane turns right, the gyroscope turns over left; the top of the wheel moves over in the opposite direction ②.

In the 1980s, laser gyroscopes began to take over the work of their mechanical, and later, electronic, forebears, without the slightest resemblance in principle or opera-

Gyros

Not on the Same Wavelength

When a laser gyro rotates, one laser beam compresses and the other elongates. A detector reads the degree and rate of rotation in the resulting interference pattern.



tion to the earlier devices. The idea behind the ring laser gyroscope actually dates back to 1913, when a French physicist, Georges Sagnac, experimented with rays of light moving in opposite directions around a circular cavity on a turntable. Sagnac showed that when he rotated the turntable, the light traveling with the rotation arrived at a target slightly after the light traveling against the rotation. He believed he had proven the existence of ether in space. In fact, he was demonstrating a property of light that came to be understood much better with the invention of the laser in the 1950s.

A laser (light amplification by stimulated emission of radiation) operates by exciting atoms in a plasma to release electromagnetic energy, or photons, in a cavity. Each end of the cavity reflects the energy back and forth, and it forms a standing wave pattern. The wave frequency—its pattern of peaks and troughs—is determined in part by the length of the cavity ③.

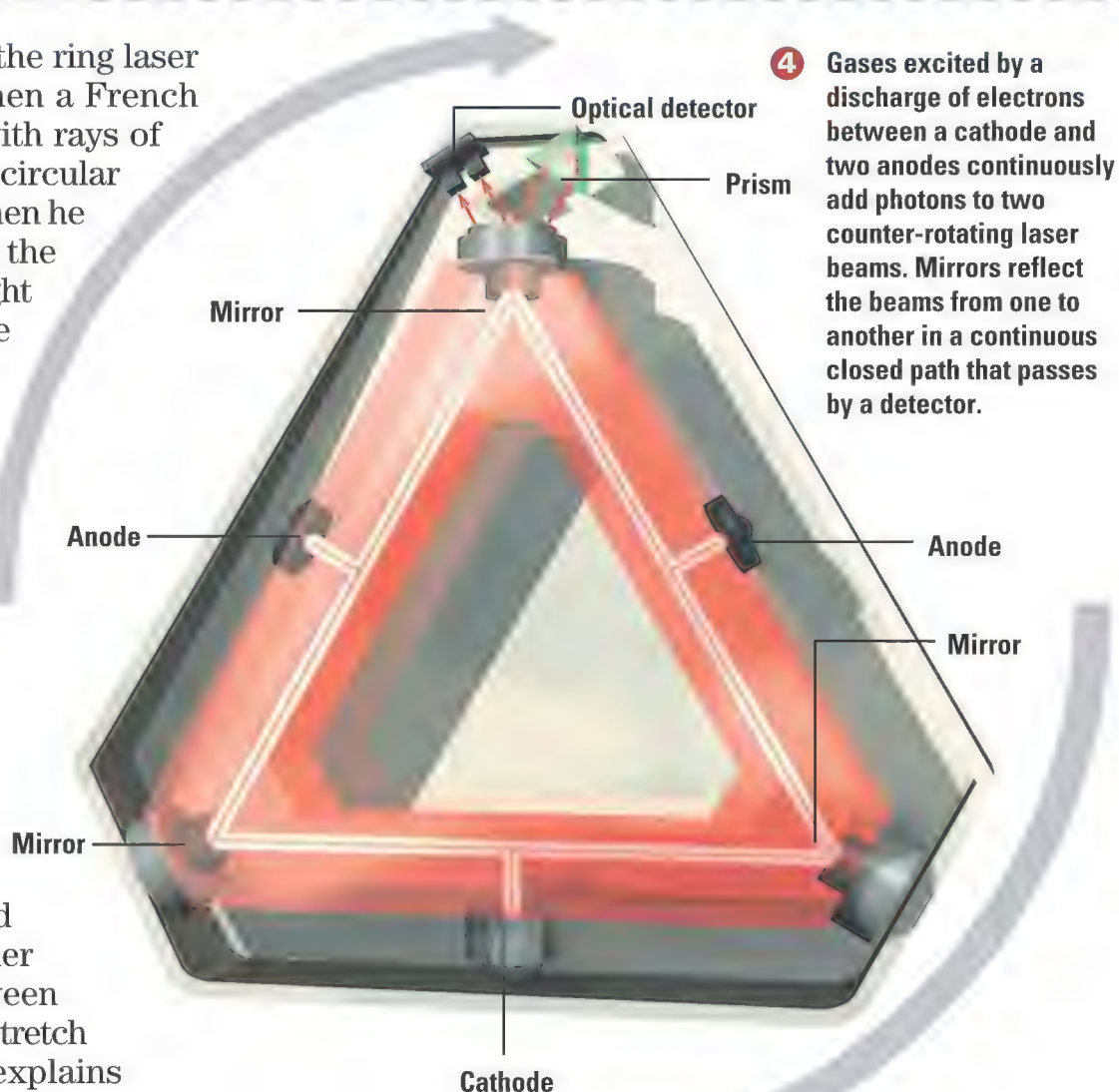
"If you had a linear laser and the light bounced back and forth between two mirrors at either end, and if you [increased] the spacing between those two mirrors slightly, you would actually stretch the wavelength of the light in the cavity," explains James Koper, the manager of ring laser gyro components for Kearfott Navigation and Guidance Systems, which manufactures the laser gyroscopes used in the B-2 bomber, the Global Hawk reconnaissance craft, and the Joint Stand-off Weapon, a glide bomb.

"What causes the light to stretch? The fact that it had to go farther. Because when it comes back, it has to come back exactly the same way it left," says Koper. "It has to resonate."

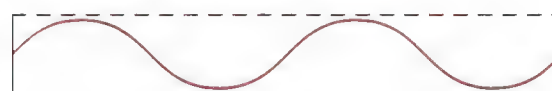
Sagnac's counter-rotating beams of light are analogous to beams in a linear cavity. If the turntable rotates clockwise, the beam traveling clockwise has farther to go to catch its starting point; the path of the counterclockwise beam is shorter.

In a given medium, "light travels at a constant velocity," Koper says. "Einstein says you can't change that. We definitely know that the beam going clockwise takes longer to get there than the beam going counterclockwise."

In a ring laser gyroscope, the two counter-rotating beams are channeled to a photo detector ④. If the vehicle is not rotating, the beams remain in phase. If rotation is occurring, one beam continuously changes phase with respect



④ Gases excited by a discharge of electrons between a cathode and two anodes continuously add photons to two counter-rotating laser beams. Mirrors reflect the beams from one to another in a continuous closed path that passes by a detector.



The wavelength of a laser beam is determined in part by the length of the cavity in which it is formed. If the length of the cavity is increased, the wavelength stretches.

to the other ⑤. A diode translates that moving interference pattern into digital pulses, each pulse representing an angle of rotation (typically .0005 degree per pulse, according to Koper). The rate at which the pulses are produced is also a measure of the rate of rotation.

In the JSOW glide bomb guidance package, Koper's company also includes GPS receivers to update the ring laser gyros, which are arranged to measure yaw, pitch, and roll. Though the gyros are necessary for the constant feedback required for flight controls, the GPS system corrects any errors that inevitably build up in inertial systems, making them dependent, if only temporarily, on something outside the instruments in the closet.

Konstantin Tsiolkovsky



BY ANATOLY ZAK
FOLLOWING IN THE
FOOTSTEPS OF THE
MAN WHO INVENTED
SPACE TRAVEL

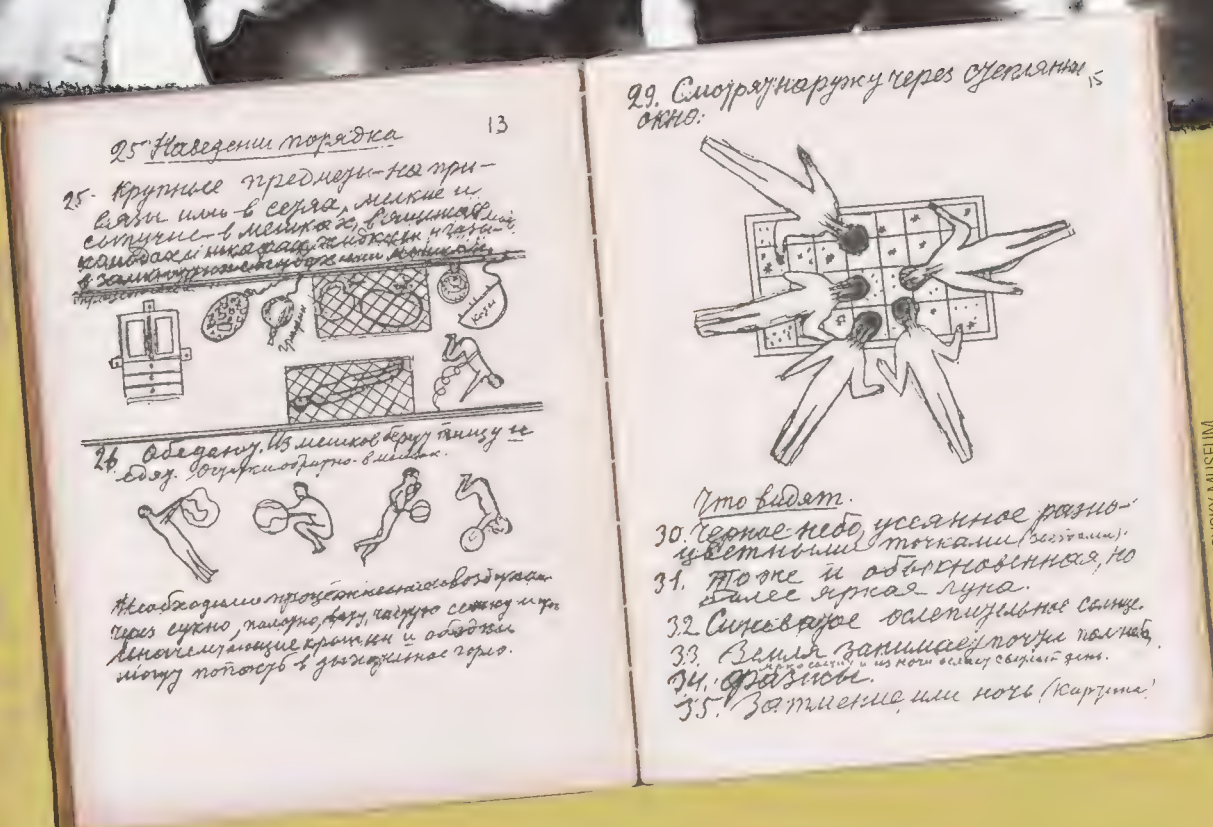
Slept Here



COURTESY FRED ORDWAY COLLECTION

In a tree-lined park not far from Moscow's Yaroslavl Highway sits a stone figure of a bearded man in a peasant-style turtleneck robe. Behind him, glittering in the sunshine, a 12-story-high steel arrow blasts a cigar-shaped rocket high into the sky over the city.

That's how generations of Russians knew Konstantin Tsiolkovsky—a visionary thinker, standing at the very foundation of their country's pioneering exploration of space. During my school days in Moscow in the 1980s, I, like most Soviet-era students, learned the story of the brilliant scientist from the Russian heartland who struggled to get recognition from the ignorant and indifferent officials of czarist Russia. It was only after the Socialist Revolution that Tsiolkovsky “experienced essentially a second creative birth,” as one Soviet history put it. Like much of the propaganda of that era, the statement wasn't quite true. In fact, Tsiolkovsky's claim to fame as the man who first proposed the use of rockets



DRAWINGS: K.E. TSIOLKOVSKY MUSEUM

Russia's first rocket scientist stayed active well into his 70s. His sketches from 1932 include a view of cosmonauts looking out at the stars. Opposite: The house in Kaluga where he spent the last 30 years of his life.

for space travel rests largely on work done before the Bolshevik revolution in 1917, and it took the Communists some time to appreciate his unorthodox ideas and not consider them a threat to their own revolutionary goals.

But by the dawn of the Space Age

in the 1950s, Tsiolkovsky's name would be recognized around the world, and he would be mentioned alongside Galileo, Kepler, and Copernicus as one of the intellectual giants who furthered humanity's expansion beyond Earth. Nearly a century after he made his most

daring prophecies and two decades after I first heard his name, I set out on a journey to find the other Tsiolkovsky—not the Soviet hero, but the solitary genius who laid out the principles of space travel when the practical means of achieving it still lay far in the future.

On a bright summer morning, with my college friend Sergei at the steering wheel, I left the noise and heat of Moscow and headed out into a countryside of dew-sprinkled meadows, emerald-colored pines, and gleaming white birch trees. We were heading south, toward the city of Ryazan. There, within Russia's "Golden Ring" of historic towns and ancient cathedrals, was the village of Izhevskoe, where Tsiolkovsky was born. The place is all but unknown to most Russians today—I struggled to find directions or even an area code for the site, and it was only after crossing the low banks of the Oka River into Ryazan itself that a motorist showed us where to go.

Finally, a scenic country road brought us to the large village where, in June 1849, Polish immigrant Eduard Ignatievich Tsiolkovsky came to work as a forester. Izhevskoe is known for the orderly layout of its streets and its well-built houses, but the first thing the traveler sees is the 1970s-era Tsiolkovsky museum, which has a bronze bust of the scientist out front.

At the time Tsiolkovsky's father settled here, the museum's youthful curator told us, the village was booming; with a population of 7,000, it was the fourth largest settlement in the Ryazan province. She directed us to the house where on September 17, 1857, the fifth of 18 Tsiolkovsky children—Konstantin, or Kostya for short—was born. We found the place in miserable condition, the result of decades of failed Soviet economic policy and post-Soviet disarray. There was no sign of any kind identifying it as a historic building.

Tsiolkovsky's family did not remain in the house for long. Soon after Kostya's birth, his father had to leave his job in Izhevskoe, and in April 1858 the family settled in Ryazan, where it remained for 10 years. There an event took place that would change Konstantin Tsiolkovsky's life forever.

"Age of 10 or 11, at the beginning of winter, I rode a toboggan," he wrote in his autobiography. "Caught a cold [actually scarlet fever]. Fell ill, was delirious. They thought I'd die, but I got better, but became very deaf and deafness wouldn't go. It tormented me very much."

The nearly complete loss of hearing left bright and active Kostya impaired for the rest of his life. At the same time, biographers agree, the disability made him turn to books and stimulated his lifelong drive for learning.

In 1868, the Tsiolkovsky family moved to Vyatka, some 500 miles northeast of Ryazan, where Kostya entered the town's school for boys. Public education was a struggle, however, and he eventually was suspended. From then on, Tsiolkovsky was entirely self-educated. "Besides books I had no other teachers," he later wrote.

A self-educated school teacher, Tsiolkovsky was of humble origin. Right: The house in Izhevskoe where he was born.

His father sent him to study in Moscow, where he taught himself at Chertkovskaya Library, which held the country's finest collection of books. His family could send only a few kopecks to support him. "I ate just black bread, didn't have even potatoes and tea," he later remembered. "Instead I was buying books, pipes, sulfuric acid [for experiments], and so on. I was happy with my ideas, and black bread didn't upset me at all."

Tsiolkovsky's arrival in Moscow coincided with profound economic and social changes in Russian society. With the abolition of feudal dependency in 1861, masses of freed peasants started moving into the city, providing the workforce for a newly industrializing Russia. The arts and sciences flourished in this changing world. It was the age of Tchaikovsky and Tolstoy. Dimitri Mendeleev developed the first periodic table of elements, and Nikolai Zhukovsky did his pioneering work on aerodynamics. In Moscow, Tsiolkovsky met Nikolai Fedorov, an eccentric Russian philosopher whose theory of "cosmism" had a profound effect on young Kostya. Fedorov prophesied that progress in science would eventually allow humans to achieve immortality and even resurrect long-dead ancestors. The population would swell so much that humanity would have to spread across the universe.

According to his biographers, these were the ideas that awakened Tsiolkovsky's interest in reaching outer space. Around this time, he also discovered the novels of French science fiction and adventure writer Jules Verne, such as *From the Earth to the Moon* (1865), which inspired a whole generation of spaceflight pioneers. Unlike most of his contemporaries, however, Tsiolkovsky did more than simply mar-



ITAR-TASS/SOVIETPHOTO





SOVPHOTO

A monument in Kaluga. Just as Americans revere Thomas Edison, every Russian knows about the father of space travel.

vel at Verne's descriptions of fantastic journeys. He questioned their practicality. He understood that shooting spacecraft from a giant cannon, Verne's method of reaching the moon, would inevitably kill its passengers due to the force of acceleration. Were there other, gentler ways of accomplishing the same thing?

In September 1879, upon his return to Ryazan, Tsiolkovsky's years of self-directed study paid off when he passed the exam to get a teacher's certificate. Around that time he began drafting his first scientific works, and even built a small centrifuge to simulate different levels of gravity and test their effects on chickens.

In January 1880, the Ministry of Education assigned 22-year-old Konstantin to teach arithmetic and geometry in the town of Borovsk. In comparison to Ryazan it was a backwater, located

The early cosmonauts were amazed by Tsiolkovsky's accurate descriptions of weightlessness. He also anticipated everything from spacesuits to staged rockets.

about 70 miles south of Moscow. Borovsk had a reputation as a town of farmers and traders, whose drunken fistfights and belief in witchcraft made them the laughingstock of the neighboring towns. It was here that Tsiolkovsky settled and raised a family.

To get to modern-day Borovsk, we had to leave the highway and drive along country roads, stopping for directions several times. As we approached our destination, the flat, densely populated Moscow suburbs gave way to wooded hills and valleys, with little signs of habitation. The first signs of Borovsk were the two onion-shaped domes of an orthodox church poking above the trees—the same church, I learned, where Tsiolkovsky married Varvara Sokolova, the daughter of a local preacher, in August 1880.

The couple rented several houses during their 12 years in Borovsk, one of which became a museum when the 140th anniversary of the scientist's birth was celebrated in 1997. Inconspicuous among the town's dachas and overgrown gardens, the house fronts a street that was uneven and unpaved. According to the museum curator, little has changed in this neighborhood since the days when Tsiolkovsky walked to his school or took his pupils to a nearby meadow to launch hot-air balloons.

While in Borovsk, Tsiolkovsky experimented with physical processes, particularly the properties of gases, which gave

him ideas for a theoretical work titled *Svobodnoe Prostranstvo*, or "Free Space." Completed in 1883, it wasn't published until 1956, long after his death. In it Tsiolkovsky made the first attempt in his decades-long effort to describe the meaning of the cosmos for humanity and the effects that vacuum and weightlessness would have on future space travelers.

The manuscript also contained a sketch considered to be one of Tsiolkovsky's earliest depictions of a spacecraft. A simple drawing shows what looks like spacesuited travelers in weightlessness, a cannon-like machine to propel the craft through the vacuum, and primitive gyroscopes to control the orientation of the ship in space. Also in Borovsk, Tsiolkovsky started drafting designs for airships, which, along with rocketry, would remain a passion for the rest of his life.

In February 1892 he was promoted to another teaching position, in the provincial capital of Kaluga, which must have seemed a metropolis compared to Borovsk. Today, road signs on the way there read like flashbacks from Russian history. Heading southwest from Moscow, you pass the village of Tarutino, site of a key victory over Napoleon's army in 1812. Next comes Obninsk, the Russian Los Alamos, where Soviet nuclear technology was born. Finally, the road reaches the town of Kaluga, which for Russians is almost inseparable from the name "Tsiolkovsky." As we crossed



ANATOLY ZAK



SOVPHOTO/ITAR-TASS

Although he never built a rocket engine, Tsiolkovsky did tinker with airship design, such as this model airframe hanging on the wall of his workshop.

the Oka River and headed into town, we saw the silhouette of a tall rocket rising above the distant hills—a full-size replica of the Vostok booster that lifted Yuri Gagarin into orbit in 1961. It's part of a complex dedicated to the father of Russian spaceflight.

Tsiolkovsky would remain in Kaluga until his death in 1935, and it was there that he created the monumental body of work that secured his place as a prophet of the Space Age. He started with a work of science fiction. In 1895, he published *Grezy o Zemle i Nebe* (Dreams of the Earth and Sky), which describes mankind's settlement of space, complete with characters who mine asteroids and build orbital greenhouses.

In 1903, he published a manuscript titled "The Exploration of the World Space with Jet Propulsion Instruments" in *Nauchnoe Obozrenie* (Scientific Review) magazine. Today this work is universally recognized as the world's

the velocity of exhaust gases, and the rocket's final speed has since become known as Tsiolkovsky's formula, and is considered one of the foundations of the science of astronautics.

Amazingly, more than two decades before Robert Goddard launched the world's first liquid-fueled rocket, Tsiolkovsky fueled his theoretical engine with a mix of liquid oxygen and liquid hydrogen, the same combination used today on the space shuttle, and still considered the most efficient of chemical rocket propellants. Tsiolkovsky arrived at the combination with little hope of testing his theory. He never attempted to build a rocket engine, let alone a spaceship. His discoveries stemmed from a thorough grounding in physics and mathematics, an awareness of the latest achievements in technology (for example, James Dewar first liquefied hydrogen in 1898), and a gift for prediction.

For all its prescient brilliance, Tsi-

olkovsky's manuscript made it to print in *Nauchnoe Obozrenie* at a bad time, just after its publisher had died and the magazine was about to fold. "Only a few copies of the magazine were distributed before the press run was confiscated," says Galina Sergeeva, deputy director for scientific research at the State Museum of the History of Cosmonautics, located near Tsiolkovsky's house in Kaluga. "Until the 1960s it was believed that this work had never made it outside Russia, when, with the help of American researchers, a copy of *Nauchnoe Obozrenie* containing Tsiolkovsky's article was discovered in the Library of Congress."

Publication dates for the scientist's early works became an issue years later when he and his followers, both in the U.S.S.R. and abroad, struggled to establish his priority in postulating key astronautical concepts. In the 1920s, Tsiolkovsky learned about the work of German space pioneer Hermann Oberth, who, working with no knowledge of Tsiolkovsky's writing, published his key proposals for rocket-powered spaceflight in 1923. Tsiolkovsky wrote to Oberth, asserting his rights as the first to conceive of rocket flight.

"Tsiolkovsky deeply cared about his priority in the field," says his granddaughter Elena Timoshenkova, director of the museum that has been made out of the Kaluga house. During this period, "He often published his work himself and would send it to leading scientists. However, there was almost no response."

"He understood precisely that he was a genius, one of those people who move humanity forward," Sergeeva adds. Ironically, it was Oberth who later helped make Tsiolkovsky's name widely known in the West by publicizing his insights.

"He understood precisely that he was a genius, one of those people who move humanity forward," Sergeeva adds. Ironically, it was Oberth who later helped make Tsiolkovsky's name widely known in the West by publicizing his insights.

The scientist's lab/workshop (above and left) was his sanctuary in the Kaluga house (right, as it appeared during his lifetime).



1892 году Константин Эдуардович переехал в Калугу.

In 1926, Tsiolkovsky published *Plan for Space Exploration*, a bold 16-step program whereby human civilization could outlive its dying sun and settle the universe. The scheme called for rocket-powered airplanes, the use of plants for life support, and solar radiation to grow food and supply energy. He predicted the need for spacefarers to use pressurized suits when leaving the spacecraft, and envisioned the construction of large orbital settlements. According to Tsiolkovsky, humans would colonize the asteroid belt, the solar system, and ultimately the galaxy.

That work was followed three years later by *Kosmicheskie Raketnye Poezda* (The Space Rocket Trains), which advanced Tsiolkovsky's earlier thoughts about multi-stage rockets. His calculations proved that building a rocket with separate stages, each of which would be jettisoned as it finished consuming its propellants, would allow a payload to be accelerated indefinitely through the vacuum.

Tsiolkovsky's publications are full of ideas that would later become common practice in aerospace engineering. He proposed using graphite rudders to steer a rocket in flight, cryogenic propellants to cool combustion chambers and nozzles, and pumps to drive propellant from storage tanks into the combustion chamber. He considered human factors as well—at the dawn of the Space Age, the first cosmonauts were amazed by Tsiolkovsky's accurate descriptions of weightlessness.

The study in the Kaluga house (below) and drawings from 1932, including a design for an airlock that cosmonauts would use to exit their spaceship.

Yet few people at the time recognized the significance of his writings. For all his neighbors in Kaluga knew, he was just a slightly eccentric schoolteacher. According to Galina Sergeeva, the townspeople “sometimes saw this almost deaf old man walking along the street, mumbling something incomprehensible to himself.” In 1899 Tsiolkovsky started teaching physics and math at Kaluga's Religious School for Girls, and many of his pupils would later recount fond memories of him. “He was able to explain difficult things in really simple terms,” says Sergeeva, citing the former students.

Modern pilgrims to the Tsiolkovsky house—a two-story wooden cottage the family bought in 1904—are taken through a gate into a small garden squeezed between the house and the property next door. Inside, the cottage is modest, almost ascetic: white walls, simple wooden furniture. The most luxurious touch on the first floor is a large chimney covered with glossy tiles decorated with traditional Russian motifs. In the dining room, which doubled as a living room, Elena Timoshenkova directs my attention to a coffee mug with the inscription “Poverty teaches and happiness spoils.” Her grandfather “was quite conservative in things,” she explains, “and his family lived strictly under his rules.”

From the hallway, a steep stairway goes up to Tsiolkovsky's workroom and lab. According to Timoshenkova, Russian cosmonauts, who made frequent visits to the house,

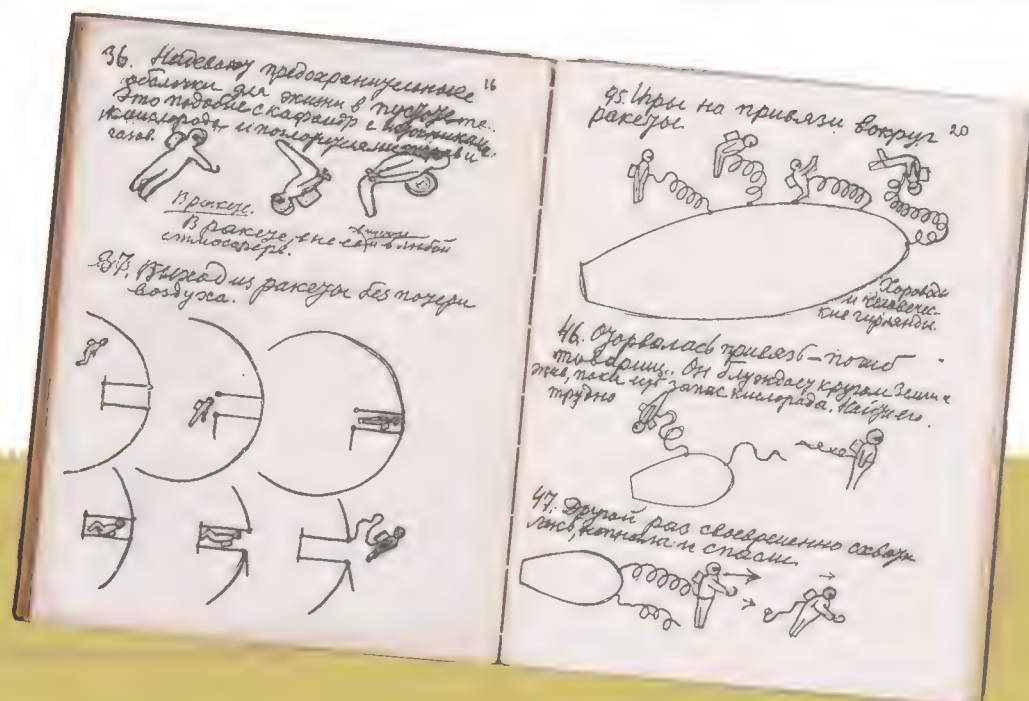


ANATOLY ZAK

A model based on Tsiolkovsky's ideas for a space rocket, at the State Museum of the History of Cosmonautics in Kaluga.

nicknamed the steps the “space stairway.” At the top of the stairs is a trap door. “His children knew,” Timoshenkova says, “when this door was closed, nobody could go upstairs to bother him. He was very strict with his children, but became much softer with the grandchildren.”

Tsiolkovsky's office has a writing desk and another desk on which are displayed various gadgets of the time, including a camera with an old-fashioned accordion-like



COURTESY FRED ORDWAY COLLECTION



case. A telescope rests on a wooden tripod by the desk. One of the windows faces a terrace that served as the scientist's lab, which for Russians is probably the most recognizable part of the Kaluga house. A long joiner's bench runs along the main wall, and a model of a metal airship is suspended from the ceiling. In a corner is the scientist's bicycle, which Timoshenkova believes was one of the first in Kaluga. In the 1930s, Tsiolkovsky was often seen riding his bike in the city's main park, which remained one of his favorite places in the last years of his life.

Today, in the middle of that park, a stone monument marks Tsiolkovsky's grave, with the engraving "Here lies the great Russian scientist Konstantin Eduardovich Tsiolkovsky 17 IX [September 17] 1857—19 IX [September 19] 1935." Shortly before his death, he wrote: "All my life I have dreamed that by my work mankind would at least be advanced a little."

Whether this wish came true is a matter of some debate. When mankind did in fact reach outer space, it was a Russian, Yuri Gagarin, who went first. But was it Tsiolkovsky's ideas that got him there? The answer is a qualified yes. Despite

the fact that his theories remained largely unknown in the West for decades, his influence on the first generation of Russian space engineers is unquestionable. In the fall of 1923, he received a letter from 15-year-old Valentin Glushko, asking for copies of the scientist's writings. There followed several years of correspondence between Tsiolkovsky and Glushko, who would grow up to be the father of Soviet rocket propulsion. "The study of Tsiolkovsky's works made me understand that the central issue in developing a means of reaching outer space is finding the optimal source of chemical energy and controlling it within the rocket engine," Glushko wrote years later. While Tsiolkovsky's work was theoretical, the younger man succeeded in practice, overseeing the development of numerous rocket engines, launch vehicles, and spacecraft beginning in the early 1930s at the famous Gas Dynamics Laboratory in Leningrad.

It is less clear how Tsiolkovsky's writing influenced Sergei Korolev, the other seminal figure in Russian rocketry and the engineer who eventually supervised construction of Gagarin's launch vehicle. Korolev had started out in aviation and only turned to rocket technology in the 1930s. Soviet-era authors, apparently with Korolev's help, introduced a legend about young Korolev making a pilgrimage to Kaluga to meet Tsiolkovsky. Modern researchers have challenged the validity of this story, but nonetheless credit Tsiolkovsky's work with helping to form Korolev's views on space travel. In his 1934 book *Rocket Flight in the Stratosphere*, Korolev wrote,

Tsiolkovsky's rocket designs used liquid hydrogen and liquid oxygen—the same propellants used in the space shuttle today. Hydrogen was first liquefied in 1898—a technical development the Russian scientist would surely have noted.

SOVPHOTO/TAR-TASS

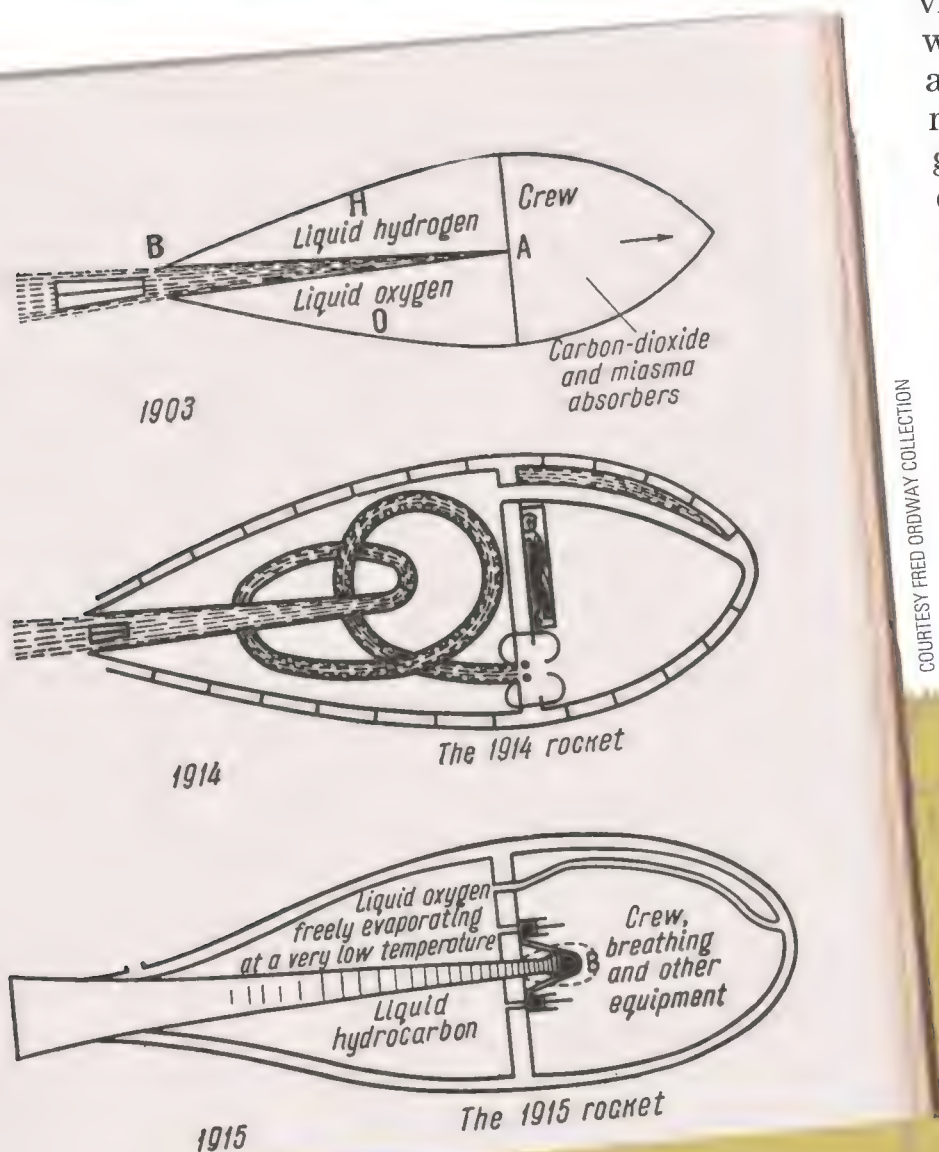


The "rocket garden" outside the cosmonautics museum in Kaluga. Tourism dropped in the post-Soviet era, but is picking back up again.

"He [Tsiolkovsky] founded the theory of rocket flight...and explored numerous issues related to manned flight at high altitude in outer space." According to Korolev's biographer Yaroslav Golovanov, the copies of Tsiolkovsky's books found in Korolev's personal library are covered in pencil notations.

The schoolteacher from Kaluga did in fact live to watch the early progress in rocketry made by Glushko, Korolev, and their colleagues in the 1930s. He consequently revised his estimates of how soon humanity would enter space. In a newspaper article published in July 1935, just a few months before his death, he wrote: "Unending work in recent times has shaken my pessimistic views: Techniques have been found that will give remarkable results within a few decades."

Tsiolkovsky died famous and respected in his native land. In the years following the Bolshevik Revolution, he enjoyed the recognition and financial support of authorities anxious to tout the superiority of the Soviet system. His scientific works were widely published and popularized, the new government granted him a pension, and he and his family were given a new house in Kaluga, where their descendants live today.



COURTESY FRED ORDWAY COLLECTION

Still, documents made public in recent years reveal that Tsiolkovsky's path through the political and social cataclysms of revolutionary Russia was not as trouble-free as the official Soviet histories portrayed it. "Like any other person who was brought up in a totally different world, he had a problem understanding what was happening," Galina Sergeeva says. "On one hand, the goals which the Revolution declared—the happiness and well-being of the people, the reconstruction of the world for the better—he obviously supported. But on the other hand, he suffered almost immediately [after the Revolution]: ChK [the Bolsheviks' notorious secret police] arrested him, brought him to Moscow, and threw him in prison." According to Sergeeva, Tsiolkovsky was accused of anti-Soviet writing and was jailed in the infamous Lubyanka prison for several weeks before a high-ranking official had him released. (In a clear sign that times have changed, it was the local branch of the Russian security service that recently transferred historical documents related to the scientist's arrest to the State Museum of the History of Cosmonautics in Kaluga.)

Even after the Soviet government embraced Tsiolkovsky as a hero, it avoided promoting his philosophical views. Although Tsiolkovsky often criticized traditional religions for their "primitive" explanation of the world, he himself saw the universe in almost theological terms, as a higher being that controls life



ANATOLY ZAK (2)

Tsiolkovsky's tomb in Kaluga. He died in 1935, just as Russian rocket pioneers were beginning to realize his dreams.

on Earth and beyond. "We are at the will of and controlled by Cosmos," he wrote in a work titled "Is There God?" "There is no absolute will—we are marionettes, mechanical puppets, machines, movie characters." Obviously, these were not ideas that fit well with official Marxist ideology.

With the end of the Soviet state, a full and honest discussion of Tsiolkovsky's legacy, good and bad, began at last. "Tsiolkovsky obviously had some wrong ideas, which were typical for his time—for example, the notion that nature has to be changed for human needs," Sergeeva says. Post-Soviet publication of his work also has brought to light his controversial views on eugenics—specifically, his advocacy of the creation of a "better" human race. Despite his remarkable gifts for prediction, Tsiolkovsky obviously did not foresee that just a few years after his death, Nazi Germany would

use eugenics to justify the murder of millions. "Eugenics was not a big part of Tsiolkovsky's philosophy; however he did have similar views," Sergeeva says.

Today, less than a mile from the scientist's home in Kaluga, is the futuristic building of the State Museum of the History of Cosmonautics. Founded in 1961 by Yuri Gagarin, the museum was intended to popularize the exploration of space and promote Soviet advances in the field. As a high school student in Moscow, I remember coming here on a tour—one of 400,000 people who visited the museum every year during the 1980s. In the post-Soviet period, however, the number of visitors to Kaluga has plunged dramatically, as have the fortunes of the Russian space program. Government-sponsored tours to Kaluga were discontinued after the collapse of the Soviet government, but Sergeeva sees the situation starting to reverse. More than 100,000 people have visited the museum in each of the past two or three years, and she sees more people coming on their own, by car or by train, rather than as part of government tours.

Toward the end of his life Tsiolkovsky wrote, "My entire life consisted of musings, calculations, practical works and trials. Many questions remain unanswered, many works are incomplete or unpublished. The most important things still lie ahead." The people who keep his legacy alive in Kaluga, and a generation raised on the triumphs and promises of the Russian space program, remain hopeful that this last statement is still true. ➔



Dreams of the Earth and Sky (1895) described humanity's move into space. Right: The scientist lecturing in 1934.

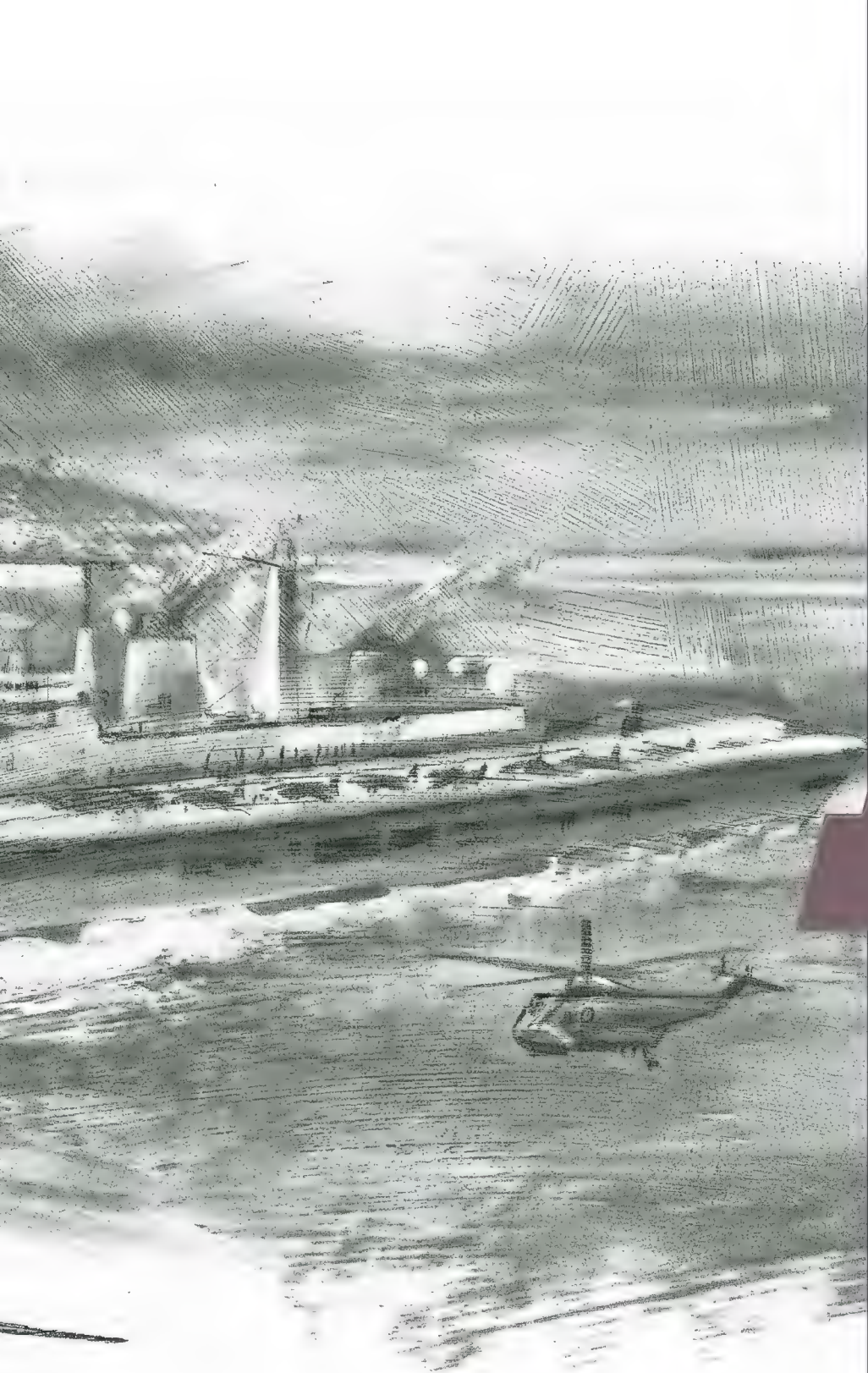


COURTESY FRED ORDWAY COLLECTION

*HMS Invincible launches her Sea Harriers on
the first day of combat in May 1982.*



AIR WAR **IN**



*Grand miscalculations,
unknown odds, miserable
weather, vast distances—
and unlikely adversaries.*

by Carl Posey

Illustrations by Paul Salmon

IN DECEMBER 1981, AN ARGENTINE scrap metal salvage team landed on the island of South Georgia, a dependency of the British Falkland Islands, and ran up the Argentine flag. HMS *Endurance* immediately brought 21 Royal Marines from East Falkland to eject the intruders, with harumphing all around. No one thought this was the beginning of a war.

As Argentina urged the United Nations to review the case of the Malvinas, the name by which the Falklands are known in much of Latin America, Operation Rosario, a plan to invade and capture the islands, took form in the Argentine capital, Buenos Aires. Argentina's claim, centuries old but fanned by nationalism since the Juan Peron era, would be vindicated; half the world away, the British would do nothing. Or so went the thinking in Argentina.

Neither of the combatants was prepared for a winter war in the far south Atlantic, and the sudden, unexpected conflict, though brief, was both improvised and lethal: In just two months of hostilities, 891 men died, 132 aircraft were lost, and 11 ships were sunk. Fought hundreds of miles from the nearest mainland, the war was decided in the air, and 20 years later, the pilots still remember every violent minute.

Argentina invaded the Falklands' capital, Port Stanley, early on Friday, April 2. Before noon, the small detachment of Royal Marines had surrendered, and the Argentine colors fluttered over Government House. But before night had fallen on occupied Port Stanley, Operation Corporate, the British counterthrust, was under way.

The carriers *Hermes* and *Invincible*, originally scheduled to be sold, had been alerted on April 1, when the invasion appeared imminent. A day later, two squadrons of Sea Harriers met the carriers at Portsmouth—Lieutenant Commander Andrew Auld's 800 Squadron was assigned to *Hermes*, while Lieutenant Commander Nigel "Sharkey" Ward's 801 Squadron was assigned to *Invincible*.

With the passing of the last conventional carrier, HMS *Ark Royal*, the Royal Navy had adopted a version of the Royal Air Force's Harrier GR.3 vertical-takeoff attack fighter. *Hermes* and *Invincible*, originally built with traditional decks, were modified by the addition of a bulbous ramp at the bow. By accelerating along the deck and up the ramp, the Harriers seemed to jump into the air, and they could carry a greater load than when they took off straight up.

The Sea Harrier differed from the RAF's GR.3 in having

THE FALKLANDS

extensive corrosion-proofing, a cockpit that was raised to provide the pilot with a better view, and a multi-mode radar called Blue Fox, which could search for targets in the air or on the sea. The airplane was unusual, its capability a mystery. One squadron might report excellent results with the radar and navigation systems, while another found them unreliable. A comparative newborn, the aircraft had never been in a real fight in the demanding maritime environment.

But British forces train with a rigor exemplified by high scores against superior aircraft in competitions. "We had fought the Sea Harrier against every airplane in the western world," says Tim Gedge, then a lieutenant commander. And the British had adopted the new U.S.-built AIM-9L Sidewinder heat-seeking air-to-air missile, with a new wide-angle sensor to improve off-boresight engagement.

"We decided to take eight aircraft but had only six pilots," Gedge recalls. "We did a troll of the RAF. We needed people who'd actually flown a Harrier but also had single-seat fighter experience.... The RAF identified two. We phoned them on Friday in Germany, in a bar" and gave them the good news: "They were going to war with the Royal Navy."

The staff at Whitehall were not as confident as the pilots, Gedge says. "I was told by [Ministry of Defence] people that attrition of Sea Harriers would be so great that all of them would be lost in the first few days of the war. I kept this to myself." Gedge was on the beach as the task force sailed out of Portsmouth on April 5. That afternoon, his mood was brightened by orders to build a new squadron—809—with aircraft coming from the factory.

The RAF sent six GR.3s, and later four more. Air Chief of Staff Sir Peter Squire, then commanding 1 (Fighter) Squadron at Wittering, says it was assumed that the Royal Navy would lose one Sea Harrier a day. "We were going down as attrition replacements," he adds.

As the 809 Squadron and the GR.3s were fitted for combat, the search for a transporter for them began. There was only *Atlantic Conveyor*, a commercial container ship. "Ship came in on a Friday," Gedge says. "We walked around. We cut up all the ventilator things, measured the flight deck. She had a 92-foot beam. We left the foremast in place, 32 feet high, to use as a guide in hover and vertical descent."

The carrier task force rendezvoused at Ascension Island with a second armada from the Mediterranean, and on April 18 the full battle group, commanded by Admiral John "Sandy"

Woodward, turned toward the south Atlantic. The group's destination, some 4,000 miles away, was an exclusionary zone 400 miles in diameter, centered on the Falklands. They would not arrive until April 30.

Most of the Argentine navy was already at sea, and on April 29, the aircraft carrier *25th de Mayo* took up station north of the exclusionary zone, while the old World War II-era cruiser *General Belgrano* patrolled to the southwest. In Buenos Aires, air force commanders brooded over how to hang onto what the navy had "recovered." They had more than ten times the combat aircraft of the British battle group, including 16 Dassault Mirage III supersonic interceptors. The navy had the formidable combination of the Dassault Super Etendard and the Exocet sea-skimming anti-ship missile, though they had only a handful of the latter, which were then embargoed by France.

But this force wasn't quite what it seemed. "Most of our

planes took part in Vietnam," says Lt. Colonel Carlos Rinke, at the time a 26-year-old lieutenant in Grupo 5 de Caza, referring to the Skyhawks. The Israeli-built Mirage V, also called the Dagger, was fast and well maintained but had no aerial refueling system, electronic countermeasures, or inertial navigation system. Argentina's pilots were long on ability and courage, but years of isolation had deprived them of priceless experience.

They had practiced combat only against themselves, and the air force had never trained to fight at sea.

The first shots of the air war were fired on April 25, when a British Wessex helicopter near South Georgia put two 250-pound depth charges next to the submarine *Santa Fe* near Grytviken. More British helicopters joined the fight, and soon the flaming sub beached itself. The Argentine garrison surrendered to British commandos, and the Union Jack was restored.

At the RAF Waddington base, five Avro Vulcan B.2s, all on their way to retirement, were instead readied for war. Having abandoned air-to-air refueling a decade earlier, the RAF had to reacquire lost skills. "We were told 'You're going up on Monday to learn air-to-air refueling,'" recalls Martin Withers, then a flight lieutenant. "The probe's on the end of the nose, below you. When you start taking fuel on, it's like being in a car wash."

But there was not much time to rehearse. At mid-morning on May 1 at Wideawake, the U.S. air base on Ascension Island, 11 Victor tankers took off a minute apart, followed



by a pair of fully armed Vulcans. The first of the flights code-named Black Buck, this deployment was also the first time Vulcans had been used in anger in 25 years of service and, at the time, the longest bombing mission ever attempted. Mechanical failures caused a Vulcan and a Victor to drop out, leaving only Withers' Vulcan and 10 tankers. As the flock pushed across the sea, Victors topped off Victors and turned back, while the remaining tankers fueled the sole Vulcan. An hour from the islands, the last tanker filled the Vulcan and banked for home, flying on fumes.

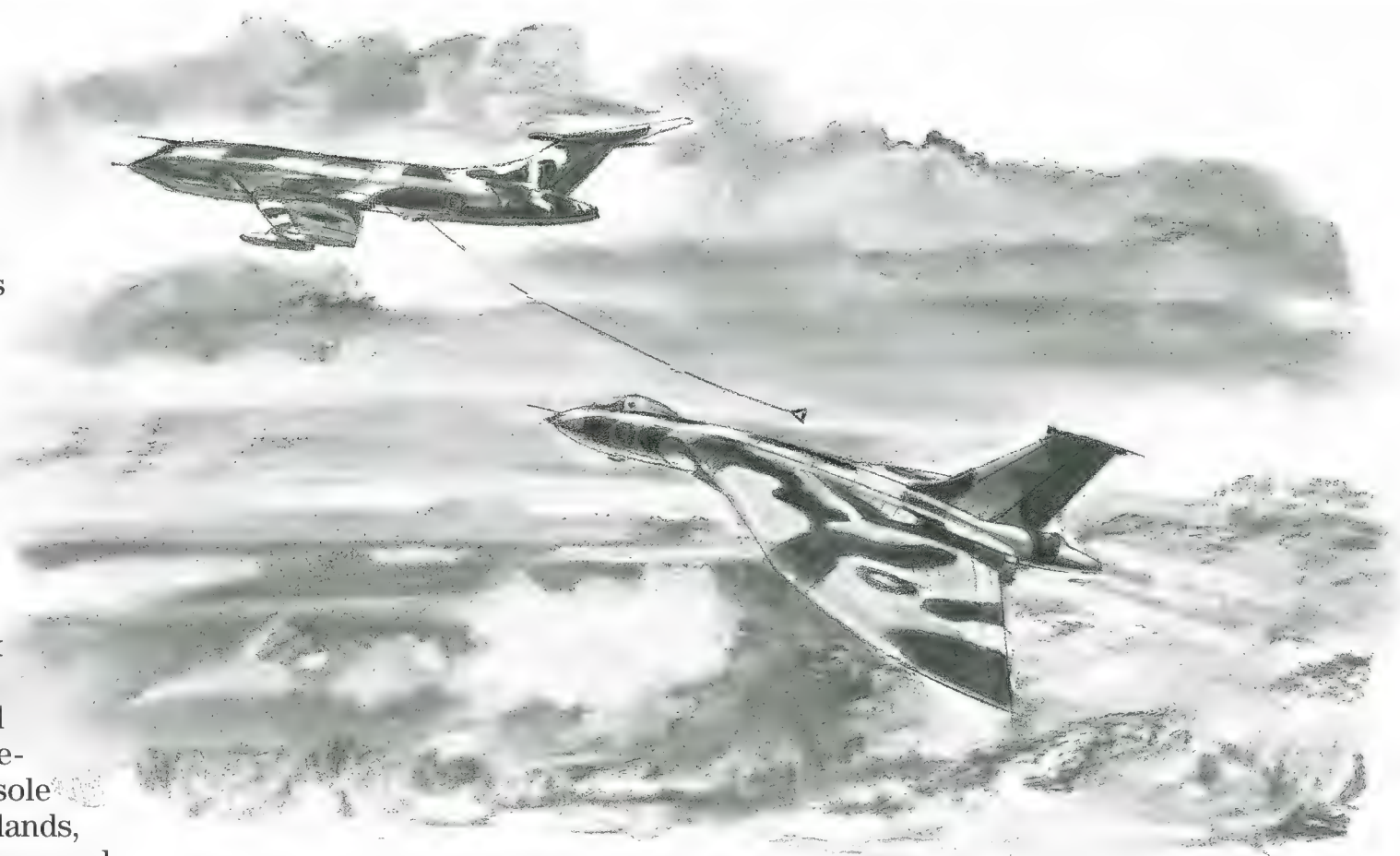
It was an odd mission for a Vulcan.

"We were a big lurching thing to go in and drop conventional bombs on a sophisticated enemy," Withers says. The Vulcan released 21 bombs on a line that angled southwest across the Port Stanley runway; the first bomb cratered the runway almost in the center; the rest missed. Even today, the perception of a lot of effort producing little result gets a rise out of Wing Commander Neil McDougall, the senior Vulcan pilot at the time. "Martin's bomb!" he sniffs. "He could only have hit it with one," given the spacing between bombs. "If you tried to bomb straight up the runway and you're just 50 feet aside, you miss." Sure enough, a second Black Buck raid two days later stitched 21 craters parallel to the runway. Withers' single hit dug a diabolical hole, producing a great upheaval of asphalt crust.

Invincible began rotating her Sea Harriers through combat air patrol (CAP) west of the fleet that same day. By mid-morning, the radar officer was reporting echoes closing fast. Lieutenant Paul Barton, flying CAP, painted six Mirages at about 35,000 feet, but the six declined to come down to fight, and the Sea Harriers would not be lured up to where the French fighter was most dangerous. As it would so often in this war, low fuel ended the dance.

The two sides skirmished throughout the day until Barton scored with a Sidewinder that shattered everything aft of one Mirage's cockpit. Wingman Steven Thomas fired at and crippled a second Mirage just as it entered cloud. The pilot limped toward Port Stanley, where Argentine guns shot him down—the first of many incidents of friendly fire.

Meanwhile, three Daggars managed to damage some British vessels with cannon fire but narrowly missed with their bombs. Two more Daggars with Israeli Shafrir heat-seekers engaged Flight Lieutenant Tony Penfold and Lieutenant Martin Hale, but the Argentine pilots fired at extreme



Victor tankers refuel Vulcan bombers.

range. One missile followed Hale into cloud before losing its lock. Moments later, the offending Dagger was nailed by Penfold and the other turned for home. Six attacking Canberra bombers were scattered, but not before one of them was dropped by a Sidewinder.

Thus ended day one, with both sides wiser. Britain had learned that little of its high-technology arsenal worked quite as the brochures had described. Shipboard anti-aircraft radar, designed for fights at sea, lost small, fast targets against the terrain, and, like all computerized entities, the units sometimes sulked. The Sea Harrier's radar also lost aircraft that were flying over land.

But so far, the Sea Harrier and AIM-9L Sidewinder had easily defeated the Mirages and Daggars sent against them. Part of that was attributable to the Argentine pilots' lack of combat experience. As they improved—and if they pressed their attacks—they would start getting hits, and by June the world would be bereft of Sea Harriers. As the British CAPs thinned, the carriers would become more exposed. But positioning the carriers out of range would sacrifice air superiority. The farther the carriers were

from the islands, the less time the Sea Harriers had to fight.

The generals in Buenos Aires also had much to ponder. Surface-to-air missiles—the Sea Dart and Sea Wolf—had been their main worry, but the Sea Harrier and Sidewinder had cost them four aircraft. The French Magic and Israeli Shafrir missiles, launched at great range, had proved useless. And then there was the Vulcan.

Like the Doolittle raid on Japan, the Vulcan strike had an effect. A nation mad enough to fly 4,000 miles to hole a runway might send Vulcans to bomb Buenos Aires. And the 4,100-foot runway at Port Stanley, already marginal for high-performance jets, was now closed to them.

The war was decided in the air, and 20 years later, the pilots who fought it can still remember every violent minute.



Sea Harriers with heat-seeking Sidewinders dominate the air action.

The next morning, about 200 miles northwest of the British fleet, *25th de Mayo* prepared a strike, but with no wind, her catapult couldn't loft a fully laden Skyhawk. *General Belgrano* was eastbound 30 miles south of the combat zone, trailed by the British nuclear submarine *Conqueror*. Sensing an Argentine pincer movement, the Royal Navy ordered the sub to strike. It hit the cruiser with two torpedoes, and two hours later *Belgrano* went down, along with 321 souls and all hope that war could be averted. With her escort, *25th de Mayo* headed to port, never to fight again.

Now all of Argentina's aircraft would have to fight from the mainland. The Super Etendards and Skyhawks could be refueled by tankers, but the Daggers couldn't; they would have barely enough fuel for the trip. The Mirage IIIs were pulled back to protect Buenos Aires from Vulcan raids—and, perhaps, to save them from the Sea Harriers.

Two days later, on May 4, an Argentine Lockheed P2V Neptune detected British warships about 85 miles south of Port Stanley. Near noon, the old airplane climbed high enough to sweep the fleet one last time, and passed its position to a pair of Super Etendards, each of which had an Exocet. The pilots were less than a year out of training at Landivision, in Brittany. "When they left France," recalls Ramón Josa, the French navy pilot who trained them, "they were 50 hours old on the Super, and not in the least ready for a South Atlantic war. But when they ran the Exocet attacks, they had something like 110 hours with the Super and they were ready."

For 200 miles, the two Supers flew only 50 feet above the waves, then, near the target, popped up to about 120 feet and briefly switched on their Agave radar units. They saw a white block: the destroyer HMS *Sheffield*. With a range

of less than 20 miles at this height, the radar evidently missed the carriers. Josa says a larger radar echo is not necessarily a larger ship; the echo is smaller when the radar sees a ship head-on and larger when in profile. "After the pop-up and looking to my radar image," he says, "I have to choose between two alternatives: launching the missile at the first target I see, or...get the carrier into missile range." The latter entails flying another 20 miles, over the missile-armed frigates—in other words, "I die before launching," says Josa. By staying low, the Argentine pilots gambled nearly half their Exocet arsenal on a small destroyer.

The Agave radar signal alerted the British ships, but it was too late. The Argentine pilots fired from about 12 miles out, then banked sharply for home. One Exocet fell into the sea. The other hit *Sheffield* amidships. The warhead failed to explode, but the impact and fire inflicted grave damage. Twenty men were killed, and five days later the ship was allowed to sink. While the destroyer burned, *Hermes* launched three Sea Harriers against a landing strip at Goose Green, where some Argentine aircraft were parked. On the first pass, the Sea Harrier flown by Lieutenant Nick Taylor was brought down by anti-aircraft fire, and he was killed.

Stunned by these losses, the battle group moved farther offshore and contemplated the day's result. The precious Sea Harriers, it was decided, would concentrate on achieving air supremacy. The RAF GR.3s, fitted with a ground attack computer and navigation system, could take up the high-risk attack role when they arrived.

But the run of bad luck hadn't ended. Two days later, two Sea Harriers on CAP were vectored to investigate a low, fast-moving echo. John Eyton-Jones and Al Curtis, among the most experienced British pilots, descended through fog almost to sea level and were never heard from again. Suddenly, the battle group was down to just 17 Sea Harriers.

The Argentine air force also had its omens. On May 9, a flight of two Skyhawks from Grupo 4 flew into a mountain shrouded in cloud. Three days later, Grupo 5 lost three Skyhawks to Sea Wolf hits. Another foursome ran in moments later, and this time the Sea Wolf system balked. A Skyhawk dropped two bombs, which skipped over a frigate and into the sea. One Skyhawk managed to hit HMS *Glasgow*, but the bomb passed through the vessel and exploded in the sea. The pilot had little chance to celebrate; his compatriots at Goose Green shot him down, and he died in the crash.

Seeing so much smoke, the Argentines believed they were scoring heavily. In fact, their British-made thousand-pounders weren't detonating. Fused to provide enough time for the

airplane to get clear before they exploded, the bombs had no time to arm at the low altitudes where the Argentines were flying. To arm and explode, they needed to be dropped from a greater height—at least 200 feet—and at that altitude, the aircraft became vulnerable to missiles. BBC World Service would reveal that little secret, but not until late May.

Her decks, hold, and containers crammed with aircraft and materiel, *Atlantic Conveyor* arrived in the area on May 18. Sea Harriers and GR.3s had boarded the ship a fortnight earlier at Ascension Island, landing on the narrow deck and parking in an improvised revetment of containers. All of the aircraft except one deck-alert jet had been cocooned against the sea. Now crews unwrapped them and flew the GR.3s to *Hermes*, and the Sea Harriers to the 800 and 801 Squadrons on both carriers.

Aboard *Hermes*, the RAF detachment encountered little of the Fleet Air Arm's rivalry—none of the *UFOs are real; it's the RAF that's an illusion* kind of thing. "It wasn't just 'The Crabs arrived,'" quips Peter Squire, referring to the Royal Navy sobriquet for members of the RAF, the color of whose uniforms calls to mind a bluish anchor-chain lubricant called "crabfat." "Many of the people knew one another, had a few beers together. That's not to say there weren't problems," Squire says.

For one thing, the RAF aircraft had gone down as replacements, with minimal ground crew. But the GR.3s were now considered reinforcements, and their maintenance fell to an already overextended naval staff. Further, on a rolling deck, the inertial navigation systems were impossible to set. "With no inertial nav, we had no dynamic means of aiming bombs," Squire explains. "We went back to the stopwatch and fixed crosshairs." Still, two days after joining *Hermes*, Squire's GR.3s were in the fight.

The action now shifted to a bay called San Carlos Water, where the British were assembling to land troops. Here, the surrounding terrain and narrow bay forced the Argentine aircraft through a gauntlet of warships stationed along predictable approaches. Like the British infantry's square, it was a defense that could be broken, but only by sustained and overwhelming force. The Argentines never cracked it wide open, but not for lack of trying. The press would call this desolate place Bomb Alley, and with good reason.

Weather blinded the Argentines to the May 21 landing, enabling the British to get a beachhead well established. But the sky suddenly cleared, revealing a tableau of ships unloading troops and materiel, with helicopters fluttering over them like moths. After some feints, what would prove a day-long wave of Argentine attacks broke over San Carlos Water. First came six Daggers, unseen and hurrying in from the north. They went after *Antrim* and managed one hit with a bomb that lodged deep in the ship but failed to explode.

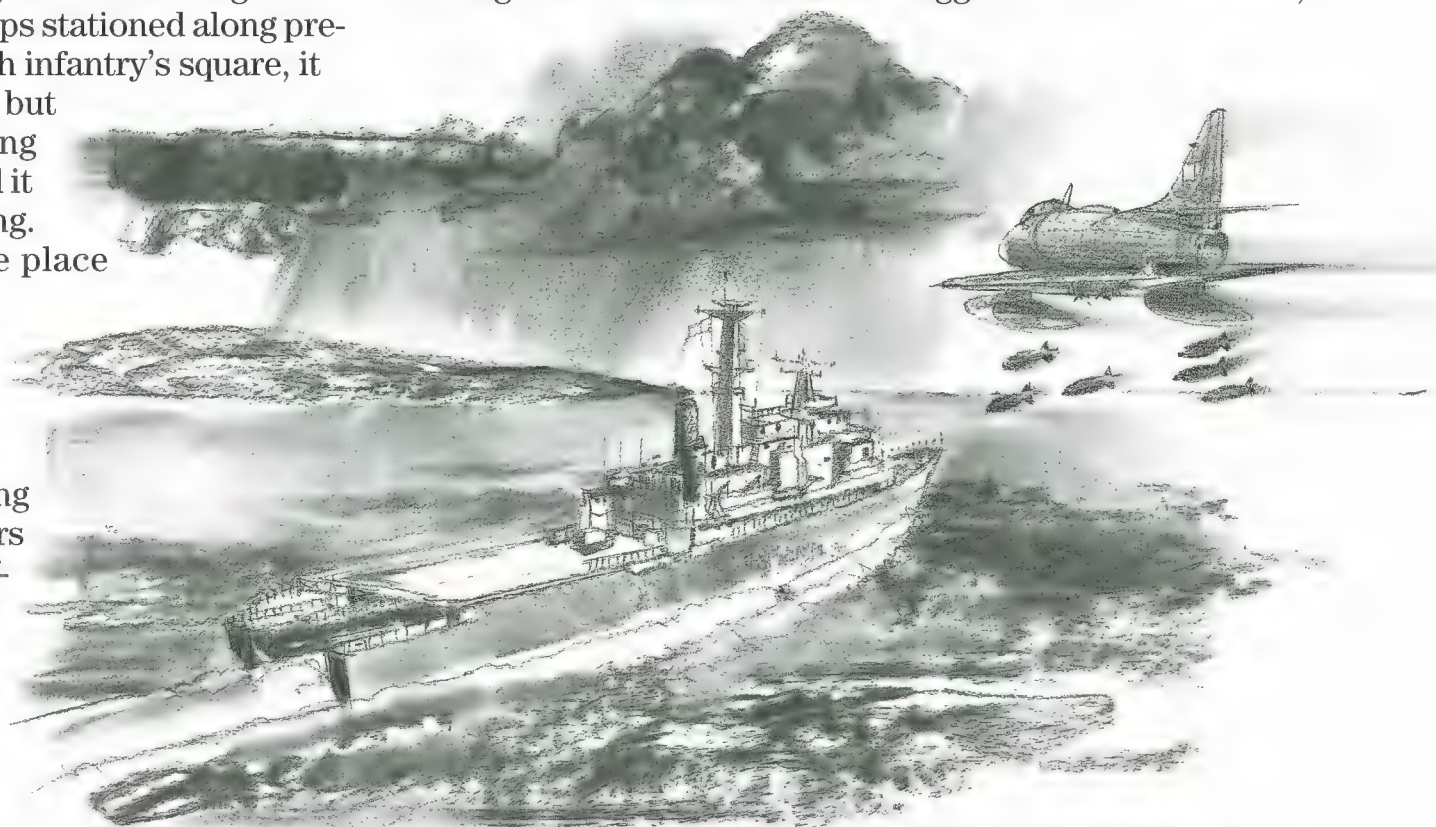
"We took off with 7,500 liters of fuel," recalls Colonel Miguel Callejo, then an air force lieutenant. "Two bombs. Maximum weight was *pasado* [exceeded]." They had radio navigation for 15 minutes, radar for another 15, then they were down to compass and clock.

Major General Horacio Mir Gonzalez, then a captain, says they flew from bases in the south. "Rio Grande, in Fireland [Tierra del Fuego]. We flew one hour, 45, 48 minutes until the islands, then operational descent and attack. If we were lucky enough to return, another 45 minutes. Two hours minimum. We returned with fuel reserves like..."—he makes a zero with a finger and thumb.

A pair of Pucará twin turboprops attacked but were turned back by *Ardent*. Sharkey Ward, on CAP, fell in behind Major Juan Tomba's airplane and peppered it with 30-mm Aden cannon fire. The first pass shot off an aileron, the second riddled the right engine, and the third ignited the left engine. "He stayed with it for three passes," Ward recalls. "After he went down I was singing his praises." Much later, Tomba was captured at Goose Green, where "we needed an interpreter," Ward continues. "Tomba at first refused. Then he heard he was a bit of a hero around the British fleet and became a first-rate interpreter, a huge help." Neill Thomas and Lieutenant Commander Mike Blissett, on CAP, picked up four inbound Skyhawks. Each Sea Harrier destroyed one and might have downed more but for low fuel.

Still the Argentines kept coming. Gonzalez was in a flight of four, at very low level: "I was the leader. We came over the hill. In front of me, more than 10, 13 frigates! Transport ships. What will I do? I see one frigate, release one bomb, flew very low level between ships." One of the four was brought down by Lieutenant Commander Rob Frederiksen.

Now six Skyhawks swept in on *Argonaut*, putting two thousand-pound bombs into her hull. Neither exploded—they were later defused—but they caused heavy internal damage. Then Gonzalez's three Daggers went after *Ardent*,



HMS Fearless under attack by Grupo 5.

catching the ship at an angle that blanked out all but her small-caliber guns. She caught a thousand-pound bomb astern; two other bombs bracketed the hull but didn't explode. Grupo 5 Skyhawks ran in, aiming for the beachhead—and also poor *Ardent*, which took two more bombs. Three Daggers strafed *Brilliant* but were picked off by 801 Squadron's Ward and Steven Thomas.

Three Argentine Navy Skyhawks attacked the crippled *Ardent*, this time with vane-retarded Snake Eye 500-pounders, most of which struck the ship and exploded. Listing badly and afire, the frigate was abandoned. It sank later that day.

The 800 Squadron CAP spotted the A-4s and went after them; none survived. With only four operational Skyhawks left, the Argentine navy would fly one more mission before leaving Bomb Alley to the air force. By the end of the day, Argentina had lost five Skyhawks, five Daggers, and two Pucarás, nine of them to Sea Harriers. The British had lost Jeff Glover's GR.3 and two helicopters to ground fire.

Contrary to expectations, the Sea Harriers and GR.3s proved effective and durable. "We flew nearly 1,500 missions, with 98 percent serviceability," says Gedge. The hapless Argentine pilots were running on nothing but courage—and the tender care of the ground crews, who spent freezing nights resuscitating the riddled aircraft.

The Sea Harriers were stretched to their range limits. Neill Thomas says that because they could land vertically, Harriers didn't need much fuel in reserve. "As we went on," he says, "we began getting shorter and shorter on fuel. You got used to it." To which Gedge adds, "You know you're going to land the first time. Landing allowance is about 400 pounds." By comparison, he notes, the figure for the F-14 is about two and a half tons.

The crews were also learning how to nurse the aircraft in harsh conditions. Gedge recalls putting "a thin cling film on the navigation stuff in the cockpit" to keep salt water out. At night, Sidewinder missiles were dried out in the bread oven. They also improvised some countermeasures: "We didn't have a chaff dispenser," recalls Rob Frederiksen, "so someone came up with putting the stuff in the air brakes."

And they flew in every kind of weather, day or night. "If we could see the wake and see the deck when we got there, we could land very safely," says Thomas. One Harrier was guided home by flares tossed behind the ship.

Because the haul to the carriers was so long, the Argentine radar at Port Stanley could watch the British fighters come and go. The fighter-bombers were now getting through a radar-detected hole in the CAP. Two days after British forces were well entrenched on the beach, Grupo 5 Skyhawks darted through such a hole, this time going after HMS *Antelope*. "I remember this mission in particular," says Carlos Rinke. "In the three minutes I had contact, flying with Guadagni-

ni. He died in that mission," shot down by a Sea Wolf from Broadsword. "That was the mission I feel in a special way because I miss my partner, my leader." But they punched two holes in *Antelope*.

Inflight refueling gave the Skyhawks greater flexibility than the Daggers. "Because of air refueling," Rinke continues, "we could fly in low levels 70 miles from the target, then 10 to 15 miles, about 10 to 20 minutes, at 30 to 60 feet. The last five minutes to the target we needed to fly very very very low. Ten feet to 30 feet. We put the throttles to maximum but the plane probably flew 450 knots, 480 knots, in low level. We reckoned we had about a 50 percent probability of returning to base."

That night, one of the unexploded bombs lodged in *Antelope* detonated, setting her afire. The frigate sank the next morning. And a Sea Harrier crashed on takeoff from *Hermes*, killing Lieutenant Commander Gordon Batt. The next day brought further losses of Argentine aircraft but little damage to the ships, as the bombs were still not arming.

Then Bomb Alley went quiet for 24 hours as the adversaries, like knife-wielding combatants in a room gone suddenly dark, briefly pulled back. May 25 would mark the 192nd anniversary of Argentina's independence, to be celebrated with deadly fireworks. Expecting trouble, Admiral John Woodward moved his battle group closer, barely 60 miles east of Port Stanley, to give the Sea Harriers more time on station, and put *Broadsword* and *Coventry* on guard north of Pebble Island.

A flock of Skyhawks probed San Carlos through the morning but were deflected by anti-aircraft fire, which destroyed one of them. Always helpful, the Argentine gunners at Goose



Hit by an Exocet, Atlantic Conveyor burns.

Green shot down another. Later, Captain Hugo Palaver's Skyhawk was killed at long range by a Sea Dart. "He was our squadron leader and a very respectful person," Carlos Rinke says. "I was very sad about his death." Afterward, he adds, "the thinking was a little bit...vengeful."

Perhaps in that spirit, six more Skyhawks headed into battle. Two turned back with technical problems, but four pressed on, attacking each northern picket ship in pairs. Sea Harriers saw the Skyhawks but were warned off by *Broadsword*—just as the ship's radar lock-on broke. Rinke and his leader made their run. Three bombs missed, but one skipped into the stern and fell into the sea on the far side without exploding.

The two Skyhawks heading for *Coventry* were also seen, but the Sea Harriers were again told to break off while the ship's anti-aircraft did the job. *Coventry* missed with a Sea Dart; then, as she maneuvered to present a smaller target, she blanked out *Broadsword*'s radar. First Lieutenant Mariano Velasco put three bombs into *Coventry*, all exploding deep inside the hull. Within minutes, the destroyer, swarming with rescue boats and helicopters, capsized.

Rinke calls it their most effective attack. "We went with four planes and returned with four planes," he says.

Even as *Coventry* died, two Super Etendards were taking off, each with an Exocet. With no Neptune to guide them, the Argentines improvised a clever alternative to find the battle group. Harriers were instructed to drop below the horizon of the Port Stanley radar 50 miles from their ships, but their disappearance from the radar screen had, over time, pointed toward one area. It wasn't perfect; a few days earlier, an Exocet mission had been scrubbed when no ships were detected. This time, the Supers flew well north to meet a tanker, then turned south to stalk the British fleet. When they sensed radar emissions, they dropped down to 50 feet.

Ahead of them, the carriers, with a thinned escort, covered *Atlantic Conveyor*, which was en route to San Carlos Water. Since the first Exocet attack, the RAF had developed a ruse: Four Lynx helicopters with electronic decoys would position themselves to lure the Exocet toward an imaginary target. With the helicopters hovering at 100 feet, the sea skimmer would pass harmlessly below them.

Forty miles northwest of *Hermes*, the Super Etendards popped up and swept the ships with their radar, which the British immediately detected. Again picking the first target they saw, the Argentine pilots launched their missiles more than 20 miles out, then veered away, outrunning the Sea Harrier CAP. The ships launched chaff and turned to bring their weaponry to bear on the Exocets.

One of the missiles evidently dropped into the sea. The other, momentarily bamboozled, flew past the carriers until its small internal radar found *Atlantic Conveyor*. The missile drove well into the hull before exploding, igniting tons of fuel. Abandoned and left to burn, the transport sank several days later, taking with her much of the materiel that

had been intended for the ground war just beginning.

Before the attack, crews aboard *Conveyor* had been feverishly "blading up" two of the RAF Chinook heavy-lift helicopters, which had been partly disassembled and covered for the crossing. One was completed and both were scheduled to enter service the next day. "They were test flying that Chinook when the ship was hit," recalls Anthony Stables, who commanded the heavy-lift squadron and watched as "three Chinooks, all support, spares, blades, tools—everything" were lost. "We then had 75 people, one Chinook.

No equipment. No armament. No fuel. Absolutely nothing. Put an end to my war, really."

The surviving Chinook—call sign Bravo November—carried troops and howitzers and tons of everything else in impossible wintry weather. During one whiteout, the big tandem-rotor helicopter caromed off a stream bed and somehow kept flying. Later it ferried 81 fully armed troops, then went back for 75 more. None of that is in the owner's manual.

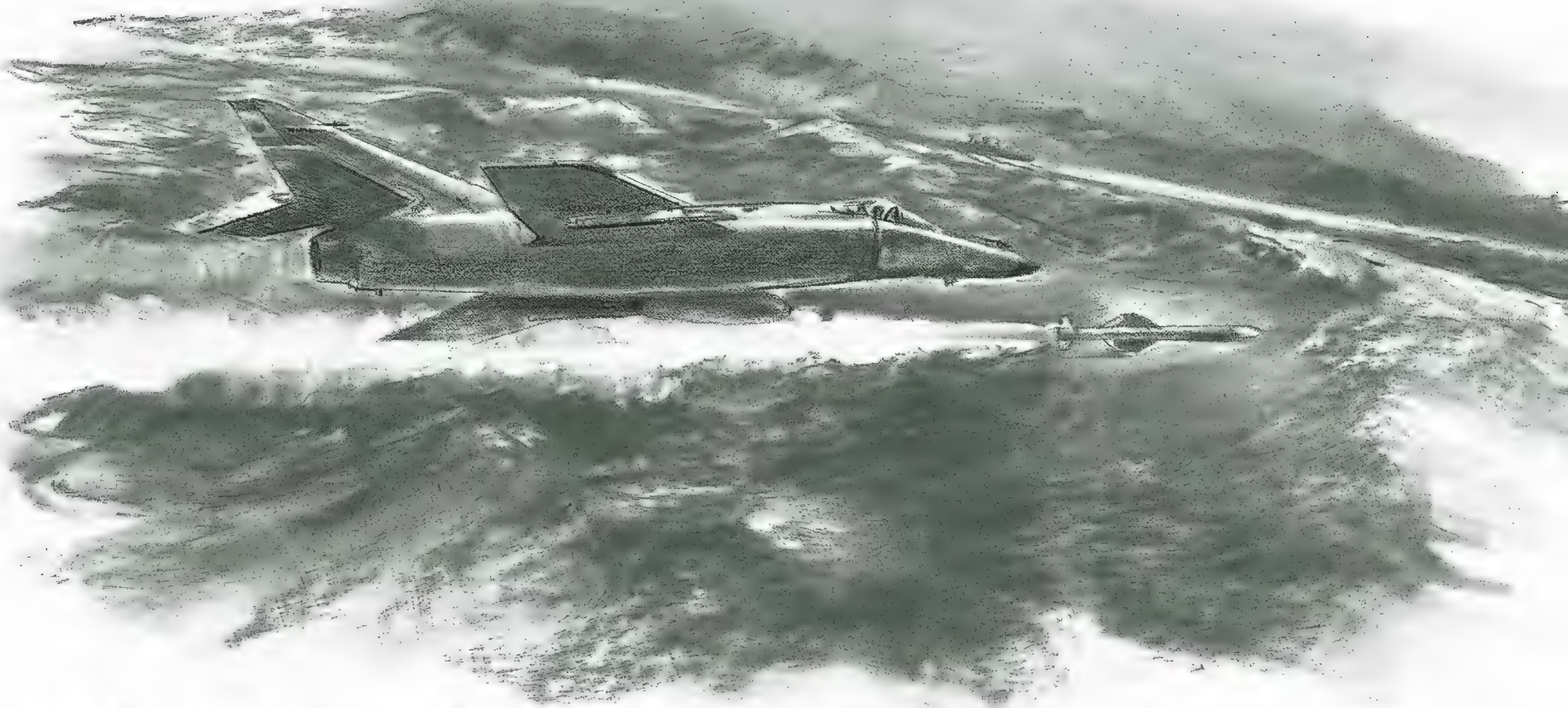
The U.S.-built Shrike missile, which homes on radars, would be employed to take out the Port Stanley radars. Two Vulcans were fitted with the weapons in May, and the missions fell to Neil McDougall. The first aborted, but two days later, on May 30, the missiles managed to silence one of the radars, but only for a day. A mission on June 2 carried four Shrikes and was destined for an excellent adventure.

After loitering for about 40 minutes and hearing nothing, McDougall eased the Vulcan down toward the runway, causing one of the anti-aircraft units to turn its radar on. Two Shrikes destroyed the battery and its crew. Still the Vulcan lingered, but the Argentines kept radar silence. McDougall finally headed north to meet his Victor. His aircraft had just started taking on fuel when the tip of the Vulcan's refueling probe broke off. The crew would have to divert to Brazil.

"Our lords and masters had designated an airfield in northern Brazil," says McDougall. "The crew had a bit of a chat. A jungle airstrip—too easy to disappear there." McDougall's crew feared that the Brazilians, to avoid a political mess, might arrange for the Vulcan to vanish. The crew quietly decided to head for Rio de Janeiro—and high visibility.

Brazilian fighters rose to meet the Vulcan, urging McDougall toward the northern field. But his remaining fuel wouldn't buy even a single go-around; he had to land. At 20,000 feet, the Vulcan was cleared for a straight-in approach to Rio about six miles from the runway—a 30-degree glide angle. McDougall, who'd been flying Vulcans for 20 years, put the huge delta-wing bomber into a steep spiral, emerging on the glide slope a mile and a half from the threshold but still making 300 knots. Pulling the nose well up, he slowed to 150 knots, dropped the wheels, and delivered a perfect landing without touching the braking parachute. "We were interned for a week," McDougall says. "We got a message one night: Refuel and get out of here in the morning; no restrictions, but do it before they change their minds." They left and landed at Ascension.

"I was very sad about his death," Carlos Rinke says of Palaver. Afterward, he adds, "the thinking was a little...vengeful."



A low-flying Super Etendard launches its Exocet.

Near the end of May, with only one Exocet left, the Argentine military devised a final gambit to sink a British carrier. Two Super Etendards, one armed and one unarmed, would stalk the fleet, accompanied by four air force A-4C Skyhawks. The Skyhawks would follow the Supers to the fleet and the Exocet to the ships.

On the early afternoon of May 30 this odd flock took off from Rio Grande. Two KC-130 tankers met them offshore and topped them off. The group flew on for another 190 miles, putting the aircraft southeast of where they believed the carriers lay. Then they descended through thick cloud and heavy rain for a long run in at 50 feet. British radar saw them coming, but lost them briefly until alerted by the Super Etendards' radar sweep. Having acquired a target presumed to be *Invincible*, they fired their single Exocet and turned away. For the Supers, the Falklands War was over.

But not for the Skyhawks. Launched some 24 miles from the presumed target, the Exocet quickly left the jets behind. Waiting for the aircraft were HMS *Avenger* and *Exeter*, one of them almost certainly the big target the Super Etendard pilot had seen. As the Skyhawks swept in, Sea Darts from *Exeter* destroyed two of them. The two survivors continued the run, each missing with two 500-pound bombs, then sped away to meet a Hercules tanker. One of them was later marked with a ship silhouette labeled "Invincible." Despite compelling evidence that no British ship—certainly not a carrier—was hit by anything that day, no one in Argentina believes the attack failed. This is the conflict's Grassy Knoll, a source of never-ending conspiracy theory. One former Grupo 4 Skyhawk pilot, Guillermo A. Martinez, now a lieutenant colonel, had studied the matter: "When does *In-*

vincible return home? September. The war ends in June," he says, knowingly. "Not even nuclear ships stay out so long."

By early June, ground targets were becoming scarce, and little apparent threat was left in the Argentine air force. Troops were assembling at Fitzroy, not 20 miles southwest of Port Stanley. The end was in sight—a perfect moment for another demonstration of Murphy's Law.

Under cover of poor weather, two landing ships had anchored in Fitzroy Bay and begun to unload. The bad weather lifted, leaving both in bright sunshine. They were consequently spotted by Argentine troops. Back at San Carlos, meanwhile, a Harrier landed hard. The aircraft was wrecked, and worse, the metal plates on a newly installed forward refueling base were twisted. The pad would be out of service for several crucial hours, cutting the Sea Harriers' ability to refuel and, in turn, their time on CAP.

Though they had no inkling of the problems the British were having, the Argentine high command chose this moment to pull out the stops: six Daggers, eight Skyhawks, and even two Mirage IIIs. The Daggers went after HMS *Plymouth*, hit her with four bombs, none of which exploded, then ran for home. As for the Skyhawks, Carlos Rinke recalls they continued with five airplanes. The five kept low and the formation split to go after the landing ships. Against little anti-aircraft fire, the pilots let their bombs go high enough to arm, and three hit one landing ship, starting a conflagration. The sister ship was also hit and set afire. The attack killed 50 and injured 57—the largest number of British casualties produced by a single action in this war.

As he approached Rio Gallegos, Rinke says, "We saw oth-

er planes were taking off. We talked with those pilots on the radio. We said it was a very easy target. We didn't realize the carrier had sent two Harriers at that moment."

The four newcomers rushed toward the smoke billowing up from Fitzroy Bay and toward a small landing craft that was being watched by two Sea Harriers on CAP. RAF Flight Lieutenant David Morgan hit two of them with Sidewinders, then pulled straight up to let his wingman, Lieutenant David Smith, take a shot, which destroyed a third Skyhawk. The encounter brought Morgan's tally to four, the most of any British pilot in the war.

"Three pilots died," says Rinke. "One was a close friend of mine. A black day for our squadron too."

Still, Grupo 5 had proved to be the most destructive of the Argentine air force units. It lost 10 aircraft and nine pilots but injured scores of British troops and destroyed *Coventry*, *Antelope*, and other vessels. The Argentine air force had demonstrated what brave and capable aviators could do with old airplanes, bombs that don't explode, and insufficient tactical training.

If the Sea Harrier was the hero of Britain's air war in the Falklands, the C-130 Hercules—the *Chancha*, or Mother Sow, as it was affectionately known—was the heroine for Argentina. The C-130s of Grupo 1 de Transporte Aereo were the prime movers for the invasion, and later, the lifeline between the mainland and the garrison. When the Neptunes dropped out, the C-130s began to use their radars to search for British ships—putting themselves very much at risk.

"Surveillance was the most complex mission," says Alberto Daguerre, a Hercules pilot at the time and now chief of the Argentine air force's air materiel command. "Using radar to detect some opportunity targets with a C-130 with fighters waiting aloft. We did that five or six times. It was very very risky, very close to the fleet, very dangerous." One C-130 out searching for the fleet turned and dropped down on the deck, headed for the mainland. It never made it.

"In some quarters in Argentina," says Sharkey Ward, "my name is not much revered. I was the guy who shot down the Hercules." It was the only C-130 lost in the conflict. After hitting one wing with a Sidewinder, Ward moved in with guns until the Hercules rolled sharply and went into the sea.

Grupo 1's two KC-130H tankers were Argentina's *Hermes* and *Invincible*, topping off outbound aircraft, then—not unlike a mother sow—nursing them back home. "The AAR [air-to-air refueling] was tremendous," Daguerre says. "The fighters were coming with a lot of leaking. A few seconds before the engine shuts down, we drop them off over the airport."

Daguerre has the distinction of flying the last C-130 mission into and out of Port Stanley. The Chanchas both opened the war and closed it. Daguerre knew June 13 was the last time he would visit Stanley. He landed in the dark with no lights. "People thought the war was lost," he says. "We flew

out 70 people, wounded and others." After a reflective pause, he continues: "When the British finally went to the airport, they couldn't believe a C-130 could land there." The Argentine garrison surrendered the next day. The same flag that had been hauled down in April was raised once more.

"I have bumped into a few Argentine air crew," says Sir Peter Squire, who has high praise for his former adversaries. His predecessor as air chief of staff was "wonderfully received" when he visited Argentina several years ago. "They took him to their air academy, showed him the honor boards," says Squire. "They take enormous pride in what they did." Squire has also met his Argentine counterpart, but such contact has been sparse. "I was approached once..." says Martin Withers. "An Argentine pilot who wanted to contact me. I wasn't interested. I'm not being nasty, I just wasn't interested. There was very little animosity between pilots."

But Withers could not resist visiting the island where he had left the crater in the runway; five years later, they were still filling it in. "I spent 24 hours down there in 1991. This time of year, weather's horrible. Freezes at night, wet during the day." He flies a Boeing 757 for a charter service now.

Tony Stables ran into an Argentine general who'd flown sorties in and out of Stanley during the war. "I used to think we'd closed the door on any flying in and out," Stables says. "He told me he flew in every night. We did sit down with a bottle of whisky, discussing those times."

On the Argentine side, with a few exceptions, the wound of defeat has not quite healed. "My feeling is not the best feeling to talk to British pilots," says Carlos Rinke. Then he shrugs. "But if one day it happens, no problem."

Former Dagger pilot Mario Callejo notes, "When I talked to a British pilot, he said it was political first and diplomatic. I told him, 'No, you don't understand what is the Malvinas for us.... Not a political affair. Not a diplomatic affair. It is

the feeling of the Argentine people.' The difference between them and us, they send professional people to fight and forget it."

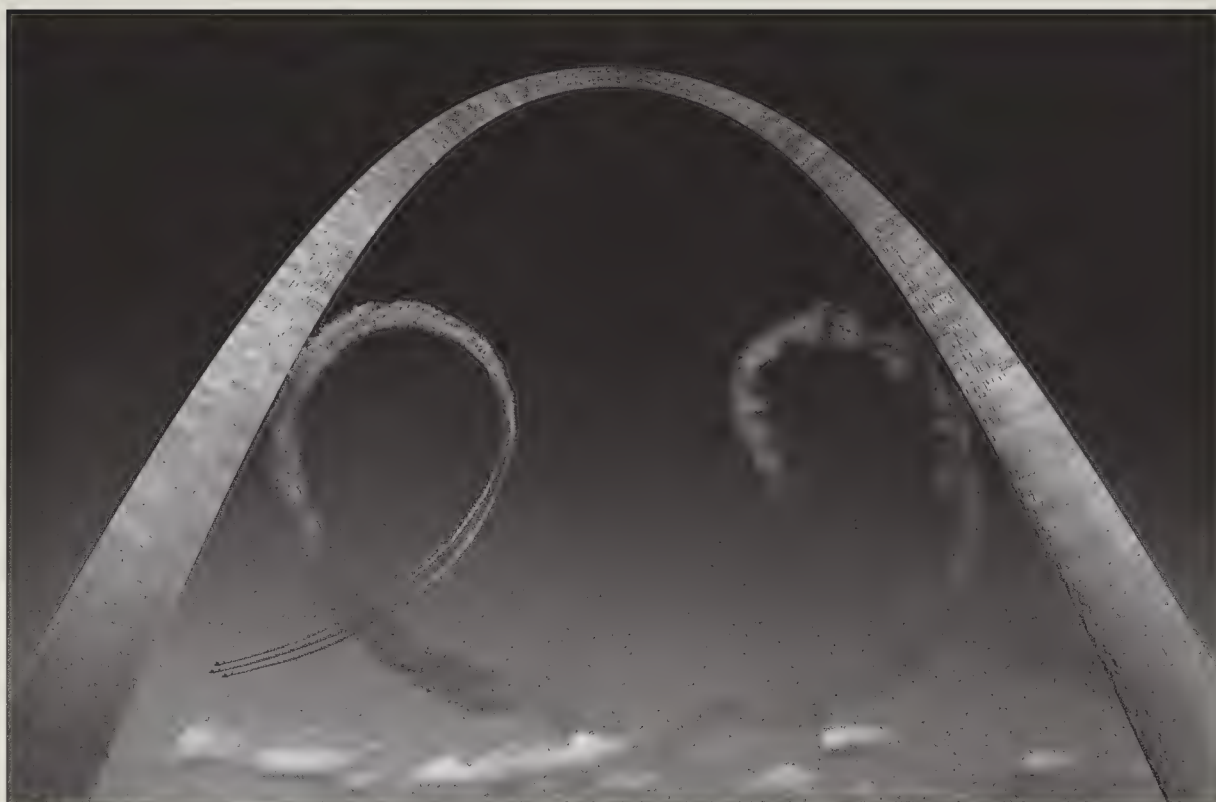
The Argentine junta did not survive; democracy returned the following year. But the defeat is celebrated in Buenos Aires the way the Confederacy is in Richmond—as a heroic lost cause. Falklanders are guarded by a strengthened garrison, RAF Tornados, airborne radar, and a few warships. Britain's revived interest in aircraft carriers endures: Two middle-size vessels are on order, and Britain is a

partner in the Joint Strike Fighter.

In Buenos Aires, lights are dimmed to save energy, banks open rarely, and one hears the melancholy creaking of an economy in collapse. The navy still has its Super Etendards, Exocets, and its ancient carrier. The air force, denied U.S. F-16s and now unable to afford them anyway, still flies Mirages and the upgraded A-4AR. The pilots train with other nations now, and that includes flying against U.S. forces a few times a year. For Argentina, the war remains one of tantalizing what-ifs—What if we'd had more Exocets? What if our bombs had armed? What if we had committed the Mirage III to combat? The wound will not close. —

After hitting one wing with a Sidewinder, Ward moved in with guns until the Hercules rolled sharply and went into the sea.





Since 1987, David Freese has traveled the airshow circuit in pursuit of the romance and magic of flight. “In the 1930s, the Italian Futurists felt that the sky was the stage and the airplane was the dancer,” he says. “That is exactly my approach.” In 1992 he flew with the Italian Frecce Tricolori when that team appeared in the United States as part of the celebration of the 500th anniversary of Columbus’ discovery of America. During a commemorative flight to New York Harbor in their Aermacchi MB-339A military jet trainers, Freese captured lower Manhattan, Ellis Island, and the Statue of Liberty in one beautifully framed image (left).

Freese was in St. Louis in 1998 when the North American Team (now the AeroShell Aerobatic Team), flying AT-6 and SNJ World War II trainers, performed near the Gateway Arch. Ever hopeful, he staked out a spot in anticipation of a fortuitous conjunction (above). “When they started the first loop, I remember thinking that this looked promising,” he says. “When they completed the second loop, I was, to say the least, ecstatic.”

Freese says his image of an Aerostar piloted by Jimmy Franklin at a 1988 show in New Jersey (below) perhaps best captures the beauty of flight. The airplane’s smoke trail combined with the clouds for a haunting effect.



Magic in the Air

Megatech Merlin

Ready-to-fly radio-controlled model airplane, from Megatech. Three-channel radio, 49.5-inch wingspan, 17 oz. flying weight. \$199.95.

Radio-controlled model airplanes have always tugged at the hearts of aviation enthusiasts, but the cost, time, effort, and risk associated with the hobby (envision months of work destroyed by a single ill-advised low-altitude hammerhead) often prevent people who aren't dedicated RC hobbyists from taking a crack at it. Now, a new generation of high-quality electric airplanes is bringing RC to the masses. These small, durable models are designed to be flown in back yards and parks, and by enthusiasts with only moderate amounts of practice and skill.

The micro-RC hobby has plenty of options for those who enjoy building and equipping their own airplanes, but there are also many ready-to-fly models that come outfitted with radio transmitters and receivers, servos to operate the controls (rudder, elevator, throttle), and rechargeable batteries. The Megatech Merlin, an attractive, slow-flying, vintage-style craft with a variety of high-strength carbon-fiber components, is an excellent introduction to this growing avocation—but it is not without its challenges.

These start with assembly. Getting the Merlin to flight-ready status does indeed take only about 20 minutes, but some steps—attaching the wings to the fuselage, for example—require a balance of care and brute force that some owners might not be able to attain. The kit would benefit from better explanations: The directions are sparse and often cryptic. And unless you happen to enjoy that sort of thing, applying the decals is an annoying step that could easily be

botched, resulting in severely compromised aesthetics.

Once you get it into the field, the Merlin is a joy to fly. It can either take off from the ground or be launched by hand, and its large foam wings and very capable propeller generate substantial lift, requiring only moderate power to navigate through the air, so plenty is left in reserve. For a first-time flier, it takes only a few minutes to get used to the controls—and just a bit longer to remember to operate them in reverse when the airplane is coming toward you. The Merlin banks gently around the sky and is easily maneuvered around obstacles. It is susceptible to even the slightest puff of wind, but as your experience builds, those same gusts can provide some exciting challenges. The flight time for each battery charge ranges from 10 to 15 minutes (though novices will, in a way, experience longer durations because of the time spent chasing it, picking it up, and re-launching it), and it re-charges in about a half-hour.

Thankfully, the Merlin is even more durable than it looks—a particularly

important quality when the pilot needs some time to

learn how to avoid over-controlling the airplane. The unit purchased for review suffered at least two dozen crashes, many alarmingly violent, and yet the wings, tail assembly, and slim fuselage sustained no damage. The same cannot be said for the propellers and the gear shaft. The kit came with only two props, both of which broke early in the trial, and the two supplied gear shafts bent quickly as well. This proved frustrating. Spare parts are easily ordered—and perhaps hobby shops will stock them—but if you're out with the kids for a fun day of flying, it could quickly be cut short if you haven't thought ahead. (Megatech could help by supplying more of these critical, and undoubtedly very inexpensive, spares with the original purchase.)

At \$200, the Merlin is an expensive proposition for those who are uncertain about how much they want to dedicate themselves to the hobby. Other options include a variety of entry-level models, such as the Sky Vector, also from



SCOTT SUCHMAN

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MegaTech, and similar models from Hobbico, Hitec, and Horizon Hobby, which retail for about \$100 to \$130. The Sky Vector is much smaller and even more durable than the Merlin. It has a radio with only two channels (for throttle and v-tail controls), and compared with the Merlin's, the battery system is not as robust nor are the components as well made, but it is still an enjoyable aircraft that can be flown at an exceedingly modest cost. In the end, you likely won't mind turning the controls over to an eight-year-old. The Merlin, though, isn't really suitable for younger children—and besides, shortcomings aside, it's so much fun, you aren't going to want to give it up.

—Eric Adams is an associate editor at Air & Space/Smithsonian.

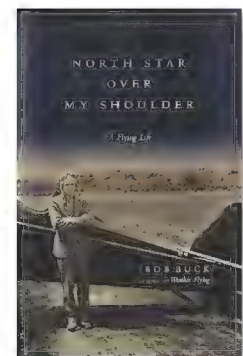
North Star Over My Shoulder: A Flying Life

by Bob Buck. Simon & Schuster, 2002. 462 pp., \$26.00 (hardbound).

Bob Buck became an airline pilot in the 1930s, when TWA was still T&WA (Transcontinental and Western Air) and its flagship was the 21-seat Douglas DC-3. A cross-country flight to Los Angeles required a day and a night, fueling stops at St. Louis, Kansas City, and Albuquerque, and three crew changes. "This was the big time, the best of its day," Buck recalls in his compelling new memoir, *North Star Over My Shoulder: A Flying Life*. "We never realized we'd be flying oceans one day, covering the world; our dream was

simply to be a senior captain and to live in L.A. and fly to Albuquerque!"

This style is Buck's hallmark: It's good writing, and it doesn't strain for the false lyricism that plagues so many aviation books. Buck writes of California



in the 1930s as "a land of orange trees, open country, unlimited visibility," where a new arrival could take "a deep breath of air perfumed by orange blossoms and perhaps a trace of eucalyptus—it was heady in those days."

He writes with equal zest about the airline experience, except for the early Douglas aircraft. They may be hallowed now, but, Buck complains, they were tough, uncomfortable birds to fly, with marginal single-engine performance and a worrisome stall—and their windows

SPACE EXPLORATION VIDEOS

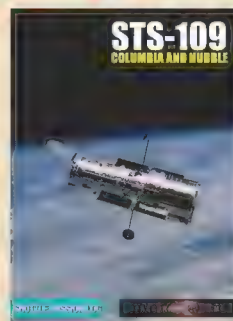
Apollo 14: Complete Downlink Edition

Apollo 11: Men on the Moon

STS-109: Columbia and Hubble

Spacecraft Films, 2002. \$24.99–\$79.99 (DVD).

Spacecraft Films has begun offering documentaries about Apollo and space shuttle missions on DVD. The digitally mastered footage was produced from original stock in NASA's archives and includes mission training, astronaut interviews, rollouts, multiple launch perspectives, and, of course, the actual missions. Viewing some of this is like watching paint dry, so the company has created detailed user interfaces that allow viewers to jump directly to key mission phases or events—something that would have been impossible with VHS videotapes—and also offers edited DVDs that condense the full-length footage (up to 12 hours each) into more manageable slices. Future releases will include other shuttle and Apollo missions as well as Gemini and Mercury flights.



leaked, the DC-2 especially. But he saw his aircraft steadily improve, and 40 years later, Buck made his last flight for TWA, a non-stop from Paris to New York in a 747 with room for more than 400 passengers. By this time, transatlantic flight was so fast and ordinary that delays on the ground could very nearly equal the five or six hours in the air. You'll be less inclined to grumble when, from reading Buck's account, you know what the crew is going through, and you'll relax even more after reading his tribute to the near-flawless engines hanging out there on the wings.

Between the eras of the small Douglasses and the Boeing jumbos, Buck pioneered international routes under

conditions so primitive that he used a sextant like those used aboard ships. He became a leading practitioner of weather research. All of this is wonderfully related, as anyone who has read his classic *Weather Flying* would expect. You learn a great deal about navigation and meteorology—thunderstorms especially—without realizing that you've been attending class.

On the other hand, I didn't need to know that the emperor of Ethiopia gave Tyrone Power "a beautiful and impressive gold cigarette case, engraved and adorned with jewels," or that Buck scored fifth-row seats to *Call Me Madam* after chatting up Irving Berlin on a London-New York flight. The triumphs of his middle age just aren't as exciting as those of his youth, so the second half of the book sometimes drags. Still, most of Buck's story is filled with earthy poetry and considerable wisdom.

—Daniel Ford is the editor of Olga Greenlaw's *The Lady and the Tigers: Remembering the Flying Tigers of World War II*, new from iUniverse.

Survival City: Adventures Among the Ruins of Atomic America

by Tom Vanderbilt. Princeton Architectural Press, 2002. 228 pp., \$25.00 (hardbound).

Although published by an architectural press as a record of now-defunct missile silos and atomic test sites scattered throughout the United States—"the Cold War as archaeology," in the author's words—*Survival City* is also about how advances in rocketry and military aviation shaped the American landscape and, to an extent, American aesthetics in the second half of the 20th century.

As the cold war fades from view, to be replaced by an era of global terrorism, the book is a timely and unusual corollary to typical military histories of the period. Men and women who served in military and civil defense jobs beginning in the 1950s may be interested to read tidbits about their colleagues' working conditions elsewhere in the far-flung system. Vanderbilt writes gracefully about a period in recent history that was shrouded in secrecy but that now reveals surprisingly matter-of-fact approaches and techniques, based in part on then-recent experiences in World War II. He skillfully weaves together his first-hand observations—his misnamed "adventures"—about mostly decommissioned cold war hardware and

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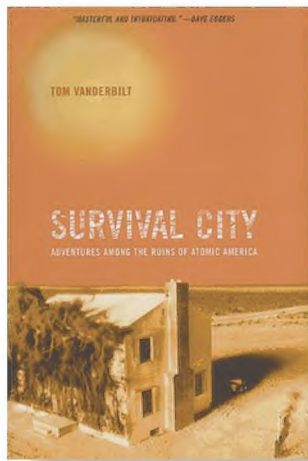
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REVIEWS & PREVIEW

operating systems from the perspectives of urban planning, archaeology, military history, and engineering. The haunting illustrations—recent black-and-white photos by the author and by Walter Cotten, intermixed with official government images—heighten the starkness of the subject matter.

Vanderbilt calls the cold war on the home front “the most expensive war that was never fought...with battlefields everywhere and nowhere.” Missiles didn’t fly, cities weren’t leveled, and soldiers, for the most part, didn’t get killed. Yet by 1967, the war’s footprint on the landscape stretched over 1,000 sites in 18 states (and cost an estimated \$5.5 trillion). Military sprawl on home soil grew from three million acres in 1937 to, at the cold war’s apex, some 30 million acres, plus another 960 million acres of reserved airspace. Unlike highly public Civil War sites, traces of the cold war were carefully hidden, sometimes in plain view, like NY-15, a 1956 Nike Ajax battery in the Bronx, and HA-48, a radar tower array in suburban Connecticut. Some more famous examples: Project Greek Island, a bunker at West Virginia’s Greenbrier Resort, and Project Hotel, President Kennedy’s island shelter near his Florida vacation home. Vanderbilt performs a useful service in showing how accessible these ruins are today—and how important as tangible cultural relics, like technology museums *in situ*—from missile silos to atomic blast test sites to underground schools to invisible mountain redoubts. The aesthetic of the American bunker never caught on among civilians, and Vanderbilt argues that



much of the open, glass-rich architecture of the 1960s was a protest against gloomy cold war imagery. He touches on aeronautic-related design as an outgrowth of society’s “crisis of symbolism,” with policy makers urging bunker-type architecture for safety as designers wanted to experiment with new building materials; he contends that this process produced such landmarks as the Vehicle Assembly Building at (then) Cape Kennedy and the Los Angeles International Airport “theme building.”

The book is most thought-provoking when Vanderbilt takes up the idea of the desert—home to much atomic testing, among other cold war activity—as a metaphor for outer space, a terrestrial test site for long-term, self-contained living in an unfriendly environment. See Paolo Soleri’s Cosmodromes, for instance, or his 2,500-person Arcosanti experimental community. And Vanderbilt interprets the interstate highway system (more precisely, the National System of Interstate and Defense Highways) as the “first space program.”

An undercurrent of menace runs through *Survival City*, building as the narrative draws to a close. The book was awaiting final editing last September 11. On that day our underground command centers, for so long unused and the butt of cold war jokes, suddenly became relevant again, when the United States really did confront an enemy who was “everywhere and nowhere.”

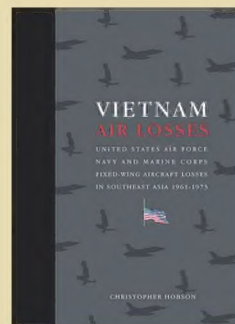
—Nan Chase, a freelance writer in Boone, North Carolina, wrote “Home Grown” (Dec. 2000/Jan. 2001), about Ozark Air Lines.

VIETNAM AIR COMBAT

Vietnam Air Losses: USAF, Navy, and Marine Corps Fixed-Wing Aircraft Losses in SE Asia 1961–1973

by Chris Hodson. Specialty Press, 2002. 192 pp., \$29.95 (paperback).

Chris Hodson has compiled massive amounts of information on every fixed-wing-aircraft loss in Vietnam. Presented in chronological order, the losses begin with the shootdown of a C-47 transport on March 23, 1961, resulting in seven deaths and one POW, and end with the crash of an F-4D Phantom landing on June 29, 1973 (both crew members survived). The information includes each aircraft’s unit, the air crew members’ names and ranks, the location of the event, the cause of the loss, and sometimes a narrative of the incident and the broader campaign. General information and material on campaigns, units, aircraft, and weapons, along with other relevant topics, are also included.



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"Hellcats of the Navy: A Remembrance of War" Seminar. American Airpower Heritage Museum, Midland, TX, (915) 563-1000.

August 16 & 17

Tri-State Aviation Expo. Buy, sell, and trade military, commercial, and general aviation memorabilia. Teterboro Airport, NJ, (201) 288-6344.

August 17 & 18

Wings of Freedom Airshow. Frederick Municipal Airport, MD, (301) 631-5357.

September 8

Pottstown Aircraft Owners and Pilots Fly-In Breakfast. Pottstown-Limerick Airport, PA, (610) 495-6366.

September 12-15

National Speed Gliding Championships. Lookout Mountain Flight Park, Chattanooga, TN, (706) 398-3541.

September 19-21

Silver Wings Fraternity Convention and Powder Puff Derby Reunion. Double Tree Hotel—Mission Valley, San Diego, CA, (925) 736-1795.

September 19-22

Reunion: 368th Fighter Group, World War II, 9th Air Force. Sixth Street Inn, Seattle, WA, (678) 333-0241.

September 21 & 22

EAA Chapter One Open House and Fly-In. Flabob Airport, Riverside, CA, (909) 682-6236.

September 24-28

Reunion: 98th Bomb Group Veterans Association. Crowne Plaza Hotel, Dayton, OH, (937) 224-0800.

September 26-29

Reunion: Army Airways Communications System Alumni Association. Marriott Hotel, Dayton, OH, (253) 474-8128.

September 28 & 29

The Great War Fly-In and Concourse. St. Louis, MO, (314) 638-1550.

Organizations wishing to have events published in Calendar should fax press releases two months in advance to (202) 275-1886 or mail them to Calendar, Air & Space/Smithsonian, MRC 951, P.O. Box 37012, Washington, DC 20013-7012.

CREDITS

Cover. "It was great fun to imagine the near future," says aerospace illustrator Paul DiMare. "I think it's important to daydream a bit, and I want to be that guy jetting over the lunar plain."

Nights Over Vietnam. Nguyen Cao Ky lives in Hacienda Heights, California. Marvin J. Wolf has written 10 non-fiction books on subjects ranging from the founder of a broadcasting empire to a Hollywood hairstylist.

Kid Stuff. John Malik is chef/owner of Culinary Capers Restaurant & Catering in Greenville, South Carolina.

Reno Enters the Jet Age. Carl Hoffman is the author of *Hunting Warbirds: The Obsessive Quest for the Lost Aircraft of World War II*.

Richard Vander Meulen is a California-based aviation photographer. His current projects include photographing the U.S. Navy's F-14 and its eventual replacement, the F/A-18E/F.

Galileo's Last Look. Tony Reichhardt is a consulting editor at *Air & Space*.

The Unemployment Line. Howard Stansfield considers himself lucky to still work as a pilot.

Etienne de Malglaive's book, *Skygate: The Aviation Photography of Etienne de Malglaive*, was published in 1999 by AirLife Publishing.

Restoration: Soggy Stratoliner. Douglas Gantenbein is the Seattle correspondent for *The Economist*.

Ticket to Orbit. Eric Adams is an associate editor at *Air & Space*.

A Waco's Happy Ending. Joshua Stoff is the author of 14 books on aviation and space history.

How Things Work: Ring Laser Gyros. Linda Shiner is the executive editor at *Air & Space*.

Konstantin Tsiolkovsky Slept Here. Anatoly Zak is a freelance journalist who has been covering the Russian space program since the end of the 1980s. A native of Moscow, he worked as a space reporter for the city's daily newspaper and currently lives in New Jersey, where he publishes *RussianSpaceWeb.com*.

Air War in the Falklands. Carl Posey's interest in the Falklands conflict dates back to a 1980s lecture given by NASA test pilot Ed Schneider at Edwards Air Force Base in California.

Paul Salmon is a Washington, D.C.-based illustrator. His work can be seen on two U.S. postal stamps and on exhibits at the Kennedy Space Center and National Air and Space Museum.

FORECAST

In the Wings...



COURTESY GEORGE MARRETT

In 1964, F-104s were stunt doubles for spaceplanes at Edwards Air Force Base.

Chuck Yeager's Charm School

How U.S. Air Force astronauts-in-training scared themselves silly flying F-104s all the way to the edge of space.

My Fighter's Better Than Yours

A glimpse inside the Lockheed and Boeing boiler rooms as the companies battled to win the contract for the Joint Strike Fighter.

The Dead End Kids

They were the most accomplished test pilots in the world. They trained for more than 15 years to be standbys in a vehicle designed to fly without human input. Then the program was canceled. Where are the pilots of the Soviet Union's Buran space shuttle?

Hired Guns

Not just any pilot can hop in a \$1 million newly restored P-51 Mustang and put it through its paces on a test flight. It takes a LOA man.

The Aussie Assault on Scram

Almost four years of work for five seconds of combustion: Why did this Queensland team take on the scramjet challenge?

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Among the rarest survivors of World War II are Waco CG-4 gliders, which carried troops and armament into battle. Visit the Web for links to the few U.S. museums that display CG-4s, to view technical drawings of the glider, and to download a paper model.



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A mess in 1987, this CG-4 underwent a seven-year overhaul at Long Island's Cradle of Aviation Museum.

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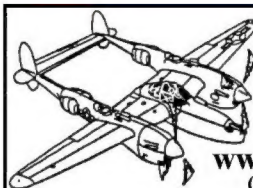
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Ten Most Wanted

Anyone with a hankering to get in the aviation record books should check out the "Ten Most Wanted Aviation Records," recently announced by the National Aeronautic Association. To set a new record, a pilot must better the standing record by at least three percent.

1 ALTITUDE in a piston engine aircraft. Any piston engine aircraft, large or small, factory-built or custom, is eligible. The current record, 56,046 feet, was set in 1938 by Mario Pezzi, an Italian, in a Caproni 161.

2 SPEED around the world (westbound) in a piston engine aircraft with a takeoff weight of 2,205 to 3,857 pounds. Measured in terms of average speed from start to finish, the clock keeps ticking at every stop. The current record is 54 mph, set by Americans Charles Classen and Phillip Greth in a Beech Bonanza in 1988. Many Cessnas, Pipers, Mooneys, Beechcraft, and homebuilts are in this weight class.

3 SPEED over a 15- to 25-kilometer (9.3- to 15.5-mile) straight course in a turboprop aircraft with a takeoff weight of 3,858 to 6,613 pounds. The current record is 220 mph, set in 1986 by Americans Robert Hayes and Jack Schweibold with a rare turbo Beech Bonanza. Either a Socata TBM 700 or a Beech T-6A Texan II would be a good bet to break this record.

4 ALTITUDE with a payload of 1,000 or 2,000 kilograms (2,210 or 4,420 pounds) in a turboprop aircraft with a takeoff weight of 13,228 to 19,841 pounds. Russia holds the record: 20,013 feet, reached in 1985 by Vladimir Lysenko in an Antonov An-3. The King Air, Beech 1900, and Swearingen-Fairchild Merlin are in this weight class.

5 DISTANCE without landing in a jet aircraft with a takeoff weight of 99,208 to 132,276 pounds. The current distance record was set by Australian Ian

Haigh, who covered 3,891 miles in a Boeing 737 in 1992.

6 DISTANCE in a closed circuit (without landing) in a piston engine seaplane. This record was set in 1937 when Italy's Mario Stoppani completed a circuit of 3,231 miles in a CRDA Cant Z.506. Possible contenders are the Consolidated PBX Catalina and the Grumman U-16 Albatross.

7 DURATION of time aloft, regardless of distance traveled, for an airship no more than 6,000 cubic meters in size. American Bryan Allen holds the record of 8 hours, 50 minutes, 12 seconds, set in 1985 in a Raven White Dwarf. Two candidates are the ABC Lightship and GSI Skyship.

8 DISTANCE without landing in a vertical-takeoff-and-landing aircraft. The current record of 423 miles, set by Germany's Drury Wood in a Dornier Do 31, has stood since 1969. An obvious candidate: the Harrier.

9 SPEED around the world over the poles in a jet aircraft. The current record of 487 mph was set in 1977 by a five-person crew in a Pan Am Boeing 747SP. They started in San Francisco, crossed the North Pole, flew over Europe and Africa, crossed the South Pole, and returned to California via New Zealand in 54 hours.

10 DISTANCE without landing in a jet aircraft. U.S. Air Force Major Clyde Evely holds the present mark-to-beat—12,532 miles—which he attained in a Boeing B-52H in 1962 by flying from Okinawa to Madrid.

As an incentive, NAA is offering a 50 percent discount on sanction and registration fees to anyone who breaks one of these records. Contact the Records Department at NAA, 1815 North Fort Myer Dr., Suite 500, Arlington VA 22209; phone (703) 527-0226, or e-mail records@naa-usa.org.

—Stuart Nixon

Awards

Evelyn B. Johnson is the winner of the 2002

Katharine Wright Award. This

award is presented annually to a woman who has made a significant contribution to the art, sport, and science of aviation, or who was instrumental in the success of another person by providing encouragement, support, and inspiration. In the course of her long aviation career, Johnson has accumulated more flying time than any other female (her current total exceeds 57,000 hours). She has participated in numerous air races, flown search-and-rescue missions, and served for 18 years as a member of the Tennessee Aeronautics Commission. She is currently a Federal Aviation Administration Designated Pilot Examiner and, in recognition of her service to the aviation community, was named an NAA Elder Statesman of Aviation in 1993.

Events

The NAA Fall Awards Dinner will be held on October 21, 2002, in Washington, D.C. Awards to be presented will include the Elder Statesman of Aviation Award, the Katherine and Marjorie Stinson Award, the Cliff Henderson Award for Achievement, and the Clarence M. Mackay Trophy. Call (800) 644-9777 for details.

First Flight

Boeing's X-45 unmanned combat air vehicle made its first flight, a 14-minute jaunt over a dry lake bed at NASA's Dryden Flight Research Center in California last May 22. Under development by the Defense Advanced Research Projects Agency and the U.S. Air Force, the X-45A UCAV will be superseded by the larger X-45B in 2005, and the Air Force hopes to see an operational squadron by 2008. However, the Air Force is questioning the conventional wisdom on unmanned air combat vehicles: Will it end up costing more to build a craft that can operate without a pilot than it will to continue fielding manned aircraft for such missions?

ALTIMETER: NASM

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